*A star (✱) indicates that the Abstract deals with Apparatus and Instruments.*

**NOVEMBER, 1937.**

# GENERAL PHYSICS.

## ADSORPTION.

**4748. Adsorption Experiments with Radon. W. Siebert.** *Zeits. f. phys. Chem.* 180. *Abt. A.* 3. *pp.* 169–184, 1937.—The adsorption of binary gas mixtures on silica gel at − 80° has been studied. One component of the mixtures was Rn, the other being one of the following: Ne, A, Kr, air, $CH_4$, $C_2H_4$, $N_2O$, and $CO_2$. The adsorption coefficient of Rn is dependent upon the gas with which it is mixed There is an approximately linear relationship between the amount of gas absorbed (given by $am/A$ ; $m$ = mass of gel, $A$ = volume of adsorption vessel, $a$ = adsorption coefficient) and the boiling point of the admixed gas. The catalytic effect of the gel on the decomposition of $C_2H_4$ is also studied. The use of the method in the study of powders, such as pigments, is indicated. A. J. M.

**4749. Heats of Adsorption of Hydrogen on Chromic Oxide at − 183° C. R. A. Beebe and H. M. Orfield.** *Am. Chem. Soc., J.* 59. *pp.* 1627–1629, *Sept.*, 1937.—An improved calorimetric method [see Abstract 5324 (1936)] is applied to the direct measurement of the differential heats of adsorption of $H_2$ on $Cr_2O_3$ at − 183°. The differential heats are of the order of 5 k.cal. for the initial stages, and decrease to 3 k.cal. in the later stages measured. It is believed that the part of the surface, for which the heat of adsorption is in the vicinity of 4 to 3 k.cal., is most probably the seat of catalytic activity in the reaction between $H_2$ and $D_2$. AUTHORS.

**4750. Specific Surface of Barium Sulphate. I. M. Kolthoff and W. M. MacNevin.** *Am. Chem. Soc., J.* 59. *pp.* 1639–1643, *Sept.*, 1937.—The specific surface of various products of $BaSO_4$ has been determined by three different methods. The simplest method is based on the determination of the amount of wool violet adsorbed in the saturated surface of barium sulphate. The method based upon the exchange between chromate and sulphate ions in the surface of $BaSO_4$ yields valuable results. The Th B method is limited to well-aged products of $BaSO_4$. AUTHORS.

**4751. Chemisorption on Charcoal. A. King.** *Chem. Soc., J. pp.* 1489–1491, *Sept.*, 1937.—Previous workers have noticed that charcoals activated at high temperatures have no power of adsorbing bases but are good acid adsorbents, while activations in the neighbourhood of 400° produce samples which adsorb bases. The adsorption of a number of acids and bases on pure charcoals activated at 15 different temperatures has now been measured, and an estimate made in each case of the adsorption per unit area. It appears that the adsorption per unit area of acids increases with temperature of activation up to about 850°, while over the same temperature range base adsorption falls to zero from a considerable value. Above 850°, base adsorption reappears to a slight extent, while that of acids decreases somewhat. These variations are in agreement with the changes in other properties with temperature of activation already studied by the author. AUTHOR.

*See also* Abstracts 4868, 5017, 5018.

## ATOMIC AND MOLECULAR STRUCTURE.

**4752. Nuclear Physics. Part III. Nuclear Dynamics, Experimental. M. S. Livingston and H. A. Bethe.** *Rev. Modern Physics,* 9. *pp.* 245–390, *July,* 1937.—The critical review of the present position is continued. The matters dealt with are: (xv) Experimental methods, properties of the various nuclear radiations, and methods of detection and observation. (xvi) Range-energy relations, stopping power and cross-section, momentum relations and recoil energy, extrapolated and mean range, and straggling. (xvii) A detailed and up-to-date account of all transformations resulting from bombardment with $\alpha$-particles (41), protons (35), deuterons (102), neutrons (174), $\gamma$-rays (19), and 12 processes resulting in more than 2 products, with 220 cases of natural or artificial radioactivity with emission of electrons (170) or positrons (150). (xviii) The mass-spectrograph and its use, mass determination from disintegration data, the excited states of nuclei, binding energies of neutrons, protons, etc., with, finally, a full list of isotopes with their relative abundance. [For Part II see Abstract 3308 (1937).] C. A. S.

**4753. Thomas-Fermi Statistical Method. E. Feenberg.** *Phys. Rev.* 52. *pp.* 758–760, *Oct.* 1, 1937.—The accuracy with which binding energies can be computed using the statistical approximation is shown to depend strongly on the symmetry character of the wave function when the forces are of the short range saturation type met with in nuclear theory. Recent calculations on the relation between the neutron excess in heavy nuclei and the saturation properties of nuclear forces are reinterpreted in the light of this result. AUTHOR.

**4754. Normal States of Nuclear Three- and Four-Body Systems. H. Margenau and Dana T. Warren.** *Phys. Rev.* 52. *pp.* 790–798, *Oct.* 15, 1937.—A variational method employing orthogonal (Hermite) functions in linear combination is used for calculating the binding energies of $H^3$ and $He^4$, with the following choice of nuclear constants: $A = 35 \cdot 60$ eMV; $a = 2 \cdot 25 \times 10^{-13}$ cm.; $g = 0 \cdot 20$, and an error function potential. Two types of coordinates are used for $H^3$; (1) normal, (2) individual particle coordinates. Their advantages and disadvantages are discussed. With the use of a certain limited set of functions of normal coordinates the energy has been depressed from $-6 \cdot 21$ eMV in zeroth approximation to $-7 \cdot 21$ eMV, while a suitable set of functions involving only individual particle coordinates reduced it from $-6 \cdot 16$ eMV to $-6 \cdot 84$ eMV. The second Schrödinger perturbation is less effective than the latter scheme by $0 \cdot 22$ eMV. Functions of different symmetry, called into play by the Heisenberg operators, are found to contribute $0 \cdot 07$ eMV on the basis of a modified variation method. $He^4$ has been treated only with the use of individual particle coordinates (Hartree method). A similar group of functions lowers the energy from $-24 \cdot 81$ eMV in zeroth approximation to $-25 \cdot 85$ eMV, which is better than the effect of Schrödinger's perturbation theory by $0 \cdot 25$ eMV. General estimates of convergence limits are given. AUTHORS.

**4755. Transmutation of Heavy Elements. (Lord) Rutherford.** *Roy. Inst., Proc.* 29. 4. *pp.* 630–635, 1937.—The transmutation of heavy elements by deuteron and neutron impact is discussed with reference to Pt, Bi and U. With U, it is probable that under neutron bombardment three new radioactive series are formed, of which the two main series are isomeric. F. C. C.

**4756. Artificial Radioactivity of Radio-Phosphorus. Yu-Yen Sha.** *Zeits. f. Physik*, 107. 1–2. *pp.* 111–131, 1937.—The use of a pressure chamber, together with a Hoffman electrometer, for the detection of positrons is described. The apparatus is used to determine the half-value period of radio-phosphorus. Measurements are made of the variation of the positron yield with the energy of the incident α-particle and two maxima are detected. The yield becomes undetectable for α-particles having a range of less than 31·2 mm. A number of measurements of the absorption of positrons in various elements are reported. The measurements comprise (1) simple absorption curves for positrons; (2) dependence of the mass absorption coefficient upon the range of the exciting α-particle and (3) dependence of the absorption upon the thickness of the bombarded Al foil. J. E. R. C.

**4757. Artificial Radioactivity by Neutron Bombardment. E. Amaldi.** *Phys. Zeits.* 38. *pp.* 692–734, *Sept.* 15, 1937.—This paper deals at great length with the subject of artificial radioactivity induced by neutron bombardment. In particular those reactions are considered in which a neutron is emitted. The retardation and distribution of neutrons in hydrocarbons are also dealt with, especially on account of the insight they give into the neutron-proton interaction. Several useful tables are given and an extensive Bibliography. G. O. B.

**4758. Efficiency of Production of Artificial Radioactive Substances by Slow Neutrons. C. J. Bakker.** *Physica*, 4. *pp.* 863–870, *Oct.*, 1937. *In English.*—The efficiency of slow neutrons for producing radio-Cl (35 min.), radio-Br (18 min.), radio-Br (4 hr.), radio-Br (36 hr.), radio-I (25 min.) and radio-Mn (2·5 hr.) has been determined. For this purpose suitable chemical compounds were dissolved in water and irradiated by the neutrons emitted from the standard Ra-Be neutron source of the laboratory. From the activities measured it was concluded that respectively 1%, 16%, 7%, (0·6%), 3%, 6% of the total number of neutrons could be made effective for the production of the radio-elements mentioned. Minimum values of the capture cross-section for slow neutrons could be determined. AUTHOR.

**4759. Induced Radioactivity of Scandium. H. Walke.** *Phys. Rev.* 52. *pp.* 669–673, *Oct.* 1, 1937.—A study has been made of the radioactivities induced in Sc by bombardment with deuterons, α-particles and slow and fast neutrons. $Sc^{46}$ has been produced by deuteron and slow neutron activation. This isotope emits low energy electrons and soft γ-radiation. The energy distribution of the electrons has been investigated by means of a large H-filled expansion chamber. The upper limit of the spectrum is at 0·89 (5) eMV in reasonably good agreement with range measurements made using Al absorbers. The half-life of $Sc^{46}$ is 85 ± 2 days. α-particle bombardment of Sc gives rise to $V^{48}$ which emits positrons and γ-rays and decays to half-value in 16·2 ± 0·3 days. Irradiation of Sc with fast neutrons from the $Be^{9} + H^{2}$ reaction results in the formation of $K^{42}$ only. Bombardment with the neutrons from the $Li + H^{2}$ reaction, however, yields $K^{42}$ and both $Sc^{43}$ and $Sc^{44}$. The Sc isotopes emit positrons and decay with half-lives of 4·0 ± 0·1 and 52 ± 2 hr., respectively. Under these conditions the reaction $Sc^{45} + n^{1} \rightarrow Sc^{43} + 3n^{1}$ is twice as probable as $Sc^{45} + n^{1} \rightarrow Sc^{44} + 2n^{1}$. No evidence has been obtained of the reaction $Sc^{45} + n^{1} \rightarrow Ca^{45} + H^{1}$. AUTHOR.

***4760. Apparatus for Production of Radioactive Elements by Means of Radium. F. T. Hamblin.** *Phil. Mag.* **24.** *pp.* 582–588, *Oct.*, 1937.—An easily manipulated apparatus is described for the production of radioactive elements by bombardment with fast or slow Ra-Be neutrons. The operator is adequately protected by suitably arranged Pb plates. C. A. S.

**4761. Radioactive Isotopes of Pd and Ag from Pd. J. D. Kraus and J. M. Cork.** *Phys. Rev.* 52. *pp.* 763–768, *Oct.* 15, 1937.—The bombardment of Pd with 6·3 eMV deuterons yields radioactive periods of 17 min. and 13 hr. (both negative) in Pd and periods of 26 min. (positive) and 180 hr. (negative) in Ag. The Pd activities are due to neutron capture and are probably attributable to $Pd^{111}$ and $Pd^{109}$, respectively. Fast neutron bombardment of Ag shows that there are undoubtedly two distinct long-period negative activities of about 180 hr. half-life in the Ag due to $Ag^{106}$ and $Ag^{111}$. The positive 26-min. Ag activity is also associated with $Ag^{106}$, being an example of the existence of isomeric isotopes. The active $Ag^{111}$ can be formed from $Pd^{110}$ directly by proton capture and indirectly by a chain reaction through $Pd^{111}$. The two 180-hr. Ag activities differ in that there is a strong $\gamma$-radiation accompanying the $\beta$-emission from $Ag^{106}$ and little or no $\gamma$-radiation from $Ag^{111}$. The upper limits of energy for the $\beta$-spectra of the 26-min. ($Ag^{106}$), 13-hr. ($Pd^{109}$), and 180-hr. ($Ag^{111}$) activities are 2·24 eMV, 1·08 eMV, and 0·80 eMV, respectively. The excitation functions for the 13-hr. ($Pd^{109}$) and 180-hr. ($Ag^{111}$) activities are determined by bombarding a stack of 25 Pd foils. These results are compared, since the processes involved correspond to the escape of a neutron or a proton from similar excited nuclei. AUTHORS.

**4762. Neutron-Induced Radioactivity of Long Life in Cobalt. J. R. Risser.** *Phys. Rev.* 52. *pp.* 768–772, *Oct.* 15, 1937.—When Co is bombarded by neutrons, an activity of long half-life is obtained. The radioactive element has been shown by a chemical analysis to be an isotope of Co. The radiations emitted in the disintegration of this element have been investigated, principally by the absorption method. A $\gamma$-ray is observed with a mass absorption coefficient in Pb of about 0·047 $cm^2$./gm., and a spectrum of soft $\beta$-rays with an estimated limiting range of 30 mg./$cm^2$. of Al, representing an energy of 160 kV. A group of more penetrating particles completely absorbed only by about 0·65 gm./$cm^2$. of Al is also indicated. This group may represent a relatively infrequent disintegration process, in which the total energy is carried off by the $\beta$-particle and no $\gamma$-ray is emitted. Results of a measurement on the half-life indicate that it is 2·0 ± 0·5 years. AUTHOR.

**4763. Radioactivity by Bombardment of Lithium with Deuterons. J. C. Bower and D. P. R. Petrie.** *Cambridge Phil. Soc., Proc.* 33. *pp.* 534–539, *Oct.*, 1937.—Using an expansion chamber, the production of two oppositely directed $\alpha$-particles, formed by the disintegration of $Be^8$ (itself produced by the impact of deuterons on Li) is demonstrated. The range of the $\alpha$-particles varies from zero to 2·5 cm. standard air with a maximum emission at about 1·2 cm. F. C. C.

**4764. Search for Protons from Li Bombarded by Ra C′ $\alpha$-Particles. W. G. Shepherd, R. O. Haxby and E. L. Hill.** *Phys. Rev.* 52. *pp.* 674–678, *Oct.* 1, 1937.—A new search has been made for protons emitted from Li under bombardment by $\alpha$-particles from Ra C′. The apparatus was designed to detect protons emitted between 50° and 120°. Protons were detected from the Li targets, but arguments are given supporting the idea that most, if not all of them arise from nitrogen contamination. Upper limits for the cross-sections are computed for the two Li isotopes. A discussion is given of the relation of the emission of protons from $Li^6$ by α-particle bombardment, and of the reverse reaction, the emission of α-particles from $Be^9$ under proton bombardment which is known to be very prolific at low proton energies. AUTHORS.

*4765. **Artificial Generator of Neutrons. E. Amaldi, E. Fermi and F. Rasetti.** *Ricerca Scientifica*, 2. *pp.* 40–43, *July*, 1937.—An apparatus for producing neutrons by the impact of 200-kV deuterons on D, according to the equation ${}_1D + {}_1D \rightarrow {}_2He + {}^1_0n$, is described. The neutron source is equivalent to a Ra + Be source of 2·5 curies. F. C. C.

**4766. Slow Neutrons. R. Fleischmann and W. Bothe.** *Ergeb. d. exakt. Naturwiss.* 16. *pp.* 1–46, 1937.—A comprehensive study of the production and properties of slow neutrons, containing over 240 references to papers on the subject published since 1934, and treated under the headings (1) general review, (2) properties of the artificially-induced radioactive nuclei, (3) associated γ-rays, (4) exchange processes, (5) absorption and scattering. F. C. C.

**4767. Excitation of Electrons by Neutrons. E. Takeda.** *Phys. Math. Soc., Japan, Proc.* 19. *pp.* 835–838, *Sept.*, 1937. *In English.*—Kikuchi, Aoki and Husimi have recently found a phenomenon which can be accounted for by supposing that electrons are emitted from atoms when they interact with neutrons [see Abstract 973 (1937)]. Gibson and others, who have studied the emission of γ-rays from Pb and Fe bombarded by fast neutrons from a Rn + Be tube, maintain that this hypothesis is not necessary to explain their results. The experiments are now repeated using Ra + Be as a neutron source, great care being taken to minimise extraneous effects. The work seems to confirm that the effect discovered by Kikuchi really exists. Assuming that 1 gm. of Ra + Be emits $10^7$ neutrons per sec., the cross-section for this process for Pb is calculated as $10^{-25}$ $cm^2$. C. J. B. C.

**4768. Diffusion of Neutrons in Crystals. G. C. Wick.** *Ricerca Scientifica*, 8. *pp.* 400–411, *May*, 1937.—The diffusion, corresponding to incoherent scattering, of neutrons passing through crystals is examined mathematically. Conditions are indicated under which a crystal may become almost perfectly transparent to neutrons. The relation of the process to that of the slowing down of neutrons is discussed. F. C. C.

**4769. Scattering of Slow Neutrons by Atomic Lattices of Crystals. Part II. G. C. Wick.** *Phys. Zeits.* 38. *pp.* 689–690, *Sept.* 15, 1937.—Referring to previous work [see Abstract 3318 (1937)], the effect of spin on the scattering of slow neutrons by atomic lattices is discussed. F. C. C.

**4770. Scattering of Protons by Neutrons. P. G. Kruger, W. E. Shoupp and F. W. Stallmann.** *Phys. Rev.* 52. *pp.* 678–684, *Oct.* 1, 1937. —The scattering of neutrons by protons has been investigated by observing recoil proton tracks with a liquid-filled cloud chamber. The neutrons used were produced by bombarding frozen $D_2O$ with 1 eMV deuterons from a small cyclotron. The tracks of 870 recoil protons have been measured. Of these tracks 635 satisfied our length selection criteria and are used as the basis of the calculations. Random track, area, and azimuthal correction factors are calculated and applied. The final curve indicates that the scattering for the energy of neutrons used in this experiment is approximately spherically symmetrical about the centre of gravity. This is in agreement with the current theory. AUTHORS.

**4771. Neutron-Proton Scattering and the Disintegration of Deuterium by Deuterons. T. W. Bonner.** *Phys. Rev.* 52. *pp.* 685–687, *Oct.* 1, 1937.—The angular distribution of the scattering of neutrons by protons has been observed by the method of recoil protons in a cloud chamber. The source of neutrons was the reaction ${}_1H^2 + {}_1H^2 \rightarrow {}_2He^3 + {}_0n^1 + Q_1$ which gave 2·6 eMV neutrons at right angles to the bombarding deuterons. The value of $Q_1$ was found to be 3·36 ± 0·20 eMV. The recoil proton distribution showed a maximum at 45° as measured in laboratory coordinates. The distribution agreed with the theoretical one which predicts a spherical symmetry with respect to the centre of mass of the moving system. AUTHOR.

**4772. Influence of Temperature on Capture of Neutrons by Various Elements. J. L. Michiels and J. A. Saxton.** *Roy. Soc., Proc.* 162*A*. *pp.* 441–449, *Oct.* 1, 1937.—The effect of temperature on the activity produced by thermal neutrons in various elements has been investigated, and no widely differing effects have been observed. The fraction of the activity of each element due to group C neutrons was determined, and the temperature effects due to those neutrons alone were deduced. From the values obtained it appears either that Cd absorbs neutrons other than those of thermal energy, or that all elements do not conform to the same absorption law in the thermal region. It was also found that the activity produced in In by group D neutrons was not influenced by temperature. AUTHORS.

**4773. Retardation of Homogeneous Neutrons by Hydrogenous Substances. G. Wetterer.** *Ann. d. Physik*, 30. 3. *pp.* 284–296, *Oct.*, 1937.—The energy loss of homogeneous neutrons, produced by bombardment of a $D_2$ compound with deuterons, on passage through paraffin has been investigated, and compared with that suffered by neutrons from a Rn-Be source possessing a wide energy spectrum. Slow neutrons were detected by B, Cd, and Ag indicators, and by means of the $\gamma$-radiation from paraffin. The results are in agreement with the view that the energy loss of the neutrons is due to elastic collisions with H-nuclei, and the causing of nuclear transformations by the slow neutrons. A. J. M.

**4774. Structure of Electronic Shells of Diatomic Homopolar Molecules. W. M. Tschulanowsky.** *Acta Physicochimica*, 7. 1. *pp.* 27–48, 1937. *In English.*—The process of the formation of a molecule from free atoms is studied in the light of spectroscopic data. The energy of dissociation and the spectroscopic state of the ground level are utilised to determine the electronic distribution of a number of diatomic homopolar molecules. H. G. C.

**4775. Coordination Numbers Eight. W. G. Penney and J. S. Anderson.** *Faraday Soc., Trans.* 33. *pp.* 1363–1368, *Oct.*, 1937.—Eight elements, Zr, Mo, Ru, Ce, Hf, W, Os, Th, are known to form coordinated complexes with eight attached atoms. With six of the eight elements, the complex has a characteristic group of 24 valency electrons. The two exceptions are Mo and W, which form complexes with groups of 25 or 26 valency electrons. These facts are shown to be predictable from the theory of molecular orbitals. AUTHORS.

**4776. Molecular Structures of Bromomethanes. H. A. Lévy and L. O. Brockway.** *Am. Chem. Soc., J.* 59. *pp.* 1662–1665, *Sept.*, 1937.—The molecular structures of the bromomethanes have been investigated by means of electron diffraction. The C–Br distance in each compound is 1·91 Å; the Br–C–Br angle is 109° 28′ in $CBr_4$, 111° in $CHBr_3$ and 112° in $CHBr_2$. AUTHORS.

**4777. Structure of Insulin. D. M. Wrinch.** *Faraday Soc., Trans.* 33. *pp.* 1368–1380, *Oct.*, 1937.—A structure is proposed for the molecule of insulin. This structure consists of a portion of the cyclol fabric bent round to enclose a portion of space. In accordance with the chemical evidence, it is simply a condensation product of amino acid molecules and contains no prosthetic group. Its molecular weight is of the right order of magnitude. Its polyhedral character offers an interpretation of the "globular" character insulin is known to possess, and explains the 8-coordination pattern in insulin crystals in terms of the apposition of faces. The dimensions of the molecule, which are derived by purely geometrical reasoning from the original hypothesis of the cyclol theory, and are thus in no sense introduced *ad hoc*, show that it fits easily into the unit rhombohedral cell given by the X-ray analysis of insulin crystals and in doing so suggests possible mechanisms of coordination between molecules. AUTHOR.

**4778. Theory of Unsaturated and Aromatic Compounds. E. Hückel.** *Zeits. f. Elektrochem.* 43. *pp.* 752–788, *Sept., and pp.* 827–849, *Oct.*, 1937.—In this comprehensive paper a survey is given of the fundamentals and limitations of modern theoretical chemistry with respect to its application to unsaturated and aromatic compounds. As far as practicable, the language used is that of general custom and explanations are given in it for the expressions of the new quantum theory. The subject matter includes a general theoretical treatment of the C = C double bond which is followed by six chapters dealing with the special applications as follows: I. The primary approximation process. II. The second approximation process. III. Energy content, whereby a comparison is made between the two processes and the experimental evidence. IV. Free radicals and related compounds. V. The reaction behaviour of the compounds. VI. Compounds which contain other elements in addition to carbon. H. H. Ho.

**4779. Atoms and Molecules. Part II. F. Hund.** *Die Physik*, 5. 4. *pp.* 119–129, 1937.—In this paper a short survey is given of very specialised researches. The following subjects are considered in the section dealing with atoms: Recent work, general theory and methods of computation, single atoms. In the molecule section the following aspects of the subject are treated: Empirical investigation of structure, diatomic molecules, rotation and oscillation of polyatomic molecules, electronic terms of polyatomic molecules and chemical bonds. The Bibliography is very comprehensive. [For Part I see Abstract 21 (1934).] H. H. Ho.

*See also* Abstracts 4857, 4858, 4912, 4952, 4955, 4958, 4974, 4976, 4994, 5029.

## COLLOIDS.

**4780. pH Properties of Colloidal Carbon. W. B. Wiegand.** *Indust. and Engin. Chem.* 29. *pp.* 953–956, *Aug.*, 1937.—If colloidal carbon pigment is boiled for 15 min. or more with 3 to 10 parts of distilled water and cooled, the sludge, when placed in contact with the glass electrode of a pH electrometer, gives a reading which is characteristic of the material. A list of values for different carbons is given. It is concluded that the effect is an adsorptive phenomemon in which the selective adsorption of the particles is a function of the volatile matter content. Heating in absence of air is found to cause a progressive rise in the pH value, and is regarded as due to changes in the amount of C–O complex associated with the C. It is pointed out that low pH values retard vulcanisation of rubber and the drying of paints and enamels, but favour dispersion, so that a compromise is desirable. L. A. W.

**4781. Coagulation Values by Photoelectric Turbidity Measurements. H. A. Wannow and K. Hoffmann.** *Kolloid Zeits.* 80. *pp.* 294–304, *Sept.*, 1937.—Continuing previous work [see Abstract 5347 (1936)] the authors give a description of a method and apparatus by which the variation of infra-red transmission of sols on addition of electrolytes is measured by means of a photo-cell. The coagulating effect of additions of KCl, $MgCl_2$ and $LaCl_3$ to $AsS_3$ sols is investigated over a range of sol concentrations from 18·7 down to 0·018 gm./l. It is found that the curves representing the variation of transmission with time do not possess points of inflection. The diminution of transmission with concentration or activity coefficient of the added electrolyte follows an S-shaped curve, the point of inflection of which furnishes better defined coagulation values than other criteria. The first activity coefficient theorem of W. Ostwald is tested and found to be quantitatively valid for a particular intermediate concentration. Investigation of the smaller sol concentrations leads to an extension of the Burton rule. L. A. W.

**4782. Theory of the Burton Rule. Wo. Ostwald.** *Kolloid Zeits.* 80. *pp.* 304–315, *Sept.*, 1937.—Continuing previous work [see Abstract 2958 (1936)] the author adduces two new examples from the literature in support of his second activity coefficient theorem. It is concluded that all the curves representing the variation of the coagulation values ($m_k$) of electrolytes with increase of concentration ($c$) of the sol descend at very low values of $c$ from very high values of $m_k$ and become differentiated only at relatively large values of $c$. A new interpretation of the Burton rule is given. It is considered that the form of the $m_k$-$c$ curve is determined (*i*) by the effect of sol dilution in diminishing the probability of collision between the particles concerned and (*ii*) by the total absorption of the electrolyte by the disperse part and the consequent dilution of the dispersion medium. L. A. W.

**4783. Change of $\epsilon$-Potential on Coagulation of Arsenious Sulphide and Silver Sols with Electrolytes. E. B. Fodiman and V. A. Kargin.** *Acta Physicochimica*, 7. 2. *pp.* 207–220, 1937. *In German.*—Potentiometric titrations of $As_2S_3$ and Ag sols against KCl, $BaCl_2$, and $La(NO_3)_3$ solutions have been carried out. The electrodes in the case of $As_2S_3$ were composed of Pt coated with $As_2S_3$ and allowed to stand in the sol for a length of time sufficient to ensure that the adsorption equilibrium between the intermicellar liquid and the surface of the electrode had been attained. For both $As_2S_3$ and Ag sols the coagulation is accompanied by a considerable variation of the p.d. between the colloidal particle and the solution. A. J. M.

**4784. Statistical Theory of the Elasticity of Rubber. E. Guth and H. Mark.** *Zeits. f. Elektrochem.* 43. *pp.* 683–685; *Disc.*, 685–686, *Aug.*, 1937.—Rubber and materials possessing similar elastic and plastic properties are composed of long chains of molecules capable of more or less motion. It is shown that the extension curve of the thermoelastic properties of rubber can be deduced both qualitatively, and, to some extent, quantitatively, by means of a statistical thermodynamic theory of the mutual interaction between chains of molecules. J. S. G. T.

**4785. Effect of Salts on the Elasticity of Gelatin. J. H. C. Merckel and E. H. Wiebenga.** *Kolloid Zeits.* 80. *pp.* 315–319, *Sept.,* 1937.—The experiments previously reported [see Abstract 988 (1937)] are extended to pH $= 3\cdot7$. The salts studied are NaCNS, NaI, NaBr, $NaNO_3$, NaCl, $NaH_2PO_4$ and NaF. It is again found that the salt concentration requisite in order to give a definite extension/load ratio is related to the lyotropic number N of the anion by a bilinear equation. The value $N = 9\cdot33$ is the critical value separating ions which increase the extension/load ratio from ions which diminish this ratio. The linear relation connecting reciprocal ionic radius and lyotropic number is substituted in the bilinear equation referred to above and it is deduced that the salt concentration requisite to give a definite extension/load ratio is inversely proportional to the difference between the radius of the ion under consideration and the radius of the ion with $N = 9\cdot33$. A possible theory is developed to explain the influence of salts upon the elasticity of gelatin.
L. A. W.

**4786. Congealing of Glasses and Artificial Plastics. E. Jenckel.** *Zeits. f. Elektrochem.* 43. *pp.* 796–806, *Oct.,* 1937.—The physical significance of the so-called transformation point of glass-like materials is investigated by measuring the alteration of viscosity and volume with time for glasses of selenium and colophony. In agreement with previous workers, it is found that the change of viscosity with temperature shows no discontinuity at the transformation point provided that the glass is always maintained for sufficiently long at the temperature of measurement. A similar result is also obtained for the change of volume with temperature and it is concluded that the transformation temperature is only a congealing temperature whose value is determined by the normal duration of laboratory experiments. Elastic after-effects and changes of volume following changes of pressure are discussed briefly. The molecular mechanism of the congealing of glasses is considered and the effect of mechanical working in modifying the properties of high-molecular, but not low-molecular, glasses is explained. L. A. W.

***4787. Action of Light on Liesegang Rings. M. F. Taboury and M. Bellot.** *Comptes Rendus,* 205. *pp.* 45–47, *July* 5, 1937.—Experiments with $Ag_2CrO_4$ formation in 1% agar-agar gel show that rhythmic precipitation occurs only (i) if soluble bromide is present, (ii) if the gel is irradiated, before diffusion commences, by light which it is capable of absorbing ($\lambda < 4960$ Å). The absorption in this case is not accompanied by insolubilisation, as in the case of gelatin. Jablczynski's law connecting the radii of successive rings is shown to be followed. L. V. C.

**4788. X-Ray Diffraction Patterns of Stretched and Crystallised Rubber. G. L. Clark, E. Wolthuis and W. H. Smith.** *Bureau of Standards, J. of Research,* 19. *pp.* 479–491, *Oct.,* 1937.—Total, sol, and gel rubber were prepared under conditions which were selected to avoid oxidation and structural changes. Total rubber when stretched and exposed to an X-ray beam produced the characteristic crystal fibre pattern. Stretched sol rubber produced no evidence whatever of this pattern even at 1000% elongation. With stretched gel rubber, the pattern was formed above 100% elongation, and at 200% was sharp and intense. A large interplanar spacing of 54 Å, found in the unstretched gel, was absent in the sol. The patterns obtained with stretched gel, with frozen sol, gel, and total rubber, and with gel crystals produced from an ethereal solution were measured and analysed. The crystals produced by all of these methods are similar. The measurements agree excellently with those reported recently by Lotmar and Meyer, and by Barnes. AUTHORS.

**4789. Change of Lattice Constants of Fibroin by Drying. Y. Matsunaga.** *Kyoto Coll. Sci., Mem.* 20. *pp.* 157–171, *July,* 1937. *In English.*—Textile fibres were examined by means of X-rays and by measuring their net densities. Fibre and powder photographs were taken when the fibres were in the ordinary state containing some moisture, and when they were kept perfectly dry in a vacuum camera. It was observed that the lattice of the crystal of silk fibres was somewhat modified by perfect drying, and returned to its original state by regaining the moisture. The results of measuring the net densities of the fibres in the primary normal alcohols and in water agree very well with those obtained by the X-ray examination. AUTHOR.

**4790. Orientation of Crystallites in Fibres. R. Hosemann.** *Zeits. f. phys. Chem.* 179. *Abt.A.* 5. *pp.* 356–360, 1937.—X-ray photographs are examined with a photometer by means of which the blackening around one of the Debye rings can be measured at intervals through the whole 360°. From these measurements the orientation of the crystallites with respect to the fibre axis can be ascertained with an accuracy of a few per cent. The author gives an example of the use of the method in the case of artificial silk fibres. J. I.

**4791. New Type of Fibre Diagram: Native and Hydrated Cellulose. E. Sauter.** *Zeits. f. phys. Chem.* 37. *Abt.B.* 1–2. *pp.* 161–167, 1937.—The author describes a method for taking X-ray photographs of a specimen formed of a bundle of fibres so arranged that the fibre axis is perpendicular to that of the specimen on a rotating X-ray goniometer. The intensity variations in the (O*k*O) reflections from native and hydrated cellulose are obtained, and it is concluded that the results of the present investigation agree better with the cellulose structure put forward by Sponsler and Dore than with that put forward by Meyer and Mark. [See Abstract 4277 (1937).] J. I.

**4792. X-Ray Fibre Diagrams of Cellulose Derivatives with a Fibre Periodicity of 15 A. J. Gundermann.** *Zeits. f. phys. Chem.* 37. *Abt.B.* 5–6. *pp.* 387–398, 1937.—The following data are given for the unit cell dimensions of five cellulose derivatives, all referred to a hexagonal cell,

| | Cu-NaOH-<br>Cellulose II | $NH_3$-<br>Cellulose II | $HClO_4$-<br>Cellulose II | *p*-Me-Cy-<br>Nitro-<br>Cellulose I | Na-<br>Cellulose II |
|---|---|---|---|---|---|
| *a*(Å) | 14·66 | 14·50 | 13·90 | 13·50 | 10·00 |
| *c*(Å) | 15·06 | 15·20 | 15·30 | 15·36 | 15·40 |

The above lattices have the same space-group which is either $C_3^2$ or $C_3^3$, so a 3-fold screw axis parallel to the fibre axis is thus indicated. The author discusses the composition of the derivatives, their density and the number of $C_6$-groups in the unit cell. J. I.

**4793. Microscopical Investigation of Synthetic High-Molecular Substances. H. Staudinger, M. Staudinger and E. Sauter.** *Zeits. f. phys. Chem.* 37. *Abt.B.* 5–6. *pp.* 403–420, 1937.—The authors have examined the micro-structure and plastic properties of crystals of polymerised polyethylene-oxide which can possess a characteristic organic fibre structure. A similar fibre structure is obtained by the mechanical deformation of single crystals of $\beta$- polyoxymethylene. Acid decomposition of single crystals of this latter compound also causes them to develop a fibrous structure, but alkali decomposition causes a peculiar periodic transverse structure which is very marked. Similarities are pointed out between these fibrous structures and the micro-structure of cellulose [see Abstract 1440 (1937)]. J. I.

***4794. Tubular Vacuum Centrifuge. J. W. Beams, F. W. Linke, and C. Skarstrom.** *Science*, 86. *pp*. 293–294, *Sept*. 24, 1937.—An air-driven vacuum ultracentrifuge in which the rotor is tubular is described. The light and heavy fractions can be separated without stopping the centrifuge. A. J. M.

***4795. Sedimentograph. H. Sauer.** *Kolloid Zeits*. 80. *pp*. 287–291, *Sept*., 1937.—The degree of fineness of materials in suspension is determined by the light absorption of the suspension, measured by means of a Pulfrich step-photometer. Suspensions of cement, heavy spar, and Bentonite were examined by the method. The measurements were shown to yield data on the grain size of the particles in suspension. F. J. B.

*See also* Abstracts 4835, 5011.

## CRYSTAL STRUCTURE AND PROPERTIES.

**4796. Energy Bands in the Body-Centred Lattice. M. I. Chodorow and M. F. Manning.** *Phys. Rev*. 52. *pp*. 731–736, *Oct*. 1, 1937.—Slater's method of finding the structure of electronic energy bands in the body-centred lattices is extended so as to satisfy boundary conditions at 14 points of the polyhedral cell surrounding an atom, instead of 8 as in previous applications. Since this requires the use of all the "*d*" spherical harmonics, the method is now applicable to elements which have "*d*" electrons. Greater accuracy is also to be expected for other elements. The expansions of the determinants relating the energy E to *k*, the wave-number vector, are given for all symmetry axes, and points, and in part for the symmetry planes. From group theory the places where various bands will stick together, *i.e.*, degeneracies required by symmetry, are also determined. AUTHORS.

**4797. Empty Lattice Test of Cellular Method in Solids. W. Shockley.** *Phys. Rev*. 52. *pp*. 866–872, *Oct*. 15, 1937.—The cellular method of constructing wave functions for electrons in crystals developed principally by Wigner and Seitz and Slater is tested by applying it to an artificial crystal in which the potential is constant. Knowledge of the exact solutions for this case, plane waves, shows that the cellular method is quite accurate in the first Brillouin zone but may be in error by a factor of two in the second. Hence calculations of occupied levels in Li and Na are probably quite good; for Cu, Ca, diamond, LiF, and NaCl the errors will be larger. Calculations of excited states are likely to be very much in error. The accuracy of the cellular method is shown to improve very slowly with increasing number of continuity conditions. AUTHOR.

**4798. Critical Ordering Temperature in Alloys. C. E. Easthope.** *Cambridge Phil. Soc., Proc*. 33. *pp*. 502–517, *Oct*., 1937.—The statistical treatment of order-disorder transformations, as developed by Bethe and Peierls [see Abstract 1422 (1936)] has been extended to alloys having superlattices of the AB and $AB_3$ types but compositions which differ slightly from the ideal compositions required for the formation of perfect superlattices. If the composition of the alloy is specified by the concentration *c* of one component, which has been chosen to be the A component, then the results show that for alloys of the AB type the critical temperature should have a maximum value when $c = \frac{1}{2}$, that is, for the ideal composition. This is in agreement with experiment. For alloys of the $AB_3$ type it is found that the maximum value should occur for some value of $c > \frac{1}{4}$. This result disagrees with that obtained experimentally, but both results agree, at least qualitatively, with those obtained by the theory of Bragg and Williams [see Abstract 4450 (1935)]. AUTHOR.

**4799. Effect of Stress on X-Ray Line Obtained with Single-Crystal Wire of Tungsten. T. Fujiwara.** *Hirosima Journ. Sci.* 7. *pp.* 315–322, *Aug.*, 1937. *In English.*—The effect of stress was examined on the X-ray spectral line obtained with a wire consisting of one single crystal of W, by using the method of convergent X-rays at room-temperature. It was found that, as a result of stretching the single crystal wire to a certain degree, broadening of the X-ray spectral lines occurred, thus illustrating the production of an elastic distortion of crystal lattice; also, small bodily movements could be found by the displacement of the spectral lines. AUTHOR.

**4800. Recrystallisation of Bent Drawn Aluminium Wire. T. Hudita.** *Hirosima Journ. Sci.* 7. *pp.* 323–326, *Aug.*, 1937. *In English.*—By means of the spectral lines obtained by using the method of convergent X-rays devised by Fujiwara, the uniformity of orientation throughout the crystal recrystallised, as one, from bent drawn Al wire was examined minutely. AUTHOR.

**4801. Structures of Compounds of P, As, Sb, Bi with Li, Na and K. G. Brauer and E. Zintl.** *Zeits. f. phys. Chem.* 37. *Abt.B.* 5–6. *pp.* 323–352, 1937.—In continuation of previous work [see Abstract 1909 (1937)] the compounds are investigated by powder and single crystal methods. $Li_3Sb$, $Li_3As$, $Li_3P$, $Na_3Bi$, $Na_3Sb$, $K_3Bi$, $K_3Sb$, $Na_3As$, $Na_3P$, $K_3As$, all crystallise in the hexagonal $Na_3As$ lattice with *a* (in Å) and *c/a* equal respectively to 4·701, 1·768; 4·387, 1·780; 4·264, 1·777; 5·448, 1·772; 5·355, 1·773; 6·178, 1·770; 6·025, 1·775; 5·088, 1·765; 4·980, 1·767; 5·782, 1·768. The unit cell has 2As in positions $\frac{1}{3}\,\frac{2}{3}\,\frac{1}{4}$, and $\frac{2}{3}\,\frac{1}{3}\,\frac{3}{4}$, and 6Na in positions $0\,0\,\frac{1}{4}$, $0\,0\,\frac{3}{4}$, $\frac{1}{3}\,\frac{2}{3}\,z$, $\frac{2}{3}\,\frac{1}{3}\,(\frac{1}{2}+z)$, $\frac{1}{3}\,\frac{2}{3}\,(\frac{1}{2}-z)$, $\frac{2}{3}\,\frac{1}{3}\,\bar{z}$; anti-isomorphous with tysonite. Apparently it can be considered as the anti-fluorite lattice of $Na_2Se$. This corresponds with the formation of solid solutions between the tysonite $La_3F$ lattice and the fluorite $SrF_2$ lattice. $Li_3Sb$ also exists in a cubic ($\beta$) modification with $Cu_3Al$ structure. From a consideration of Goldschmidt values already known, it appears that there is no limiting radius quotient factor.

D. R. H.

**4802. Cu-Pt System. J. O. Linde.** *Ann. d. Physik,* 30. 2. *pp.* 151–164, *Sept.*, 1937.—Measurements are made of the specific electrical resistance and the lattice dimensions of Cu-Pt alloys which have been subjected to various heat treatments, particular attention being paid to tempered alloys having the CuPt structure. In the case of alloys corresponding to more than 63% Pt (atomic) new superlattice lines are observed which are explained as being due to the regular replacement of Cu atoms in the trigonal CuPt structure by excess Pt atoms. J. T.

**4803. Amorphous State of Metals. J. Kramer.** *Zeits. f. Physik,* 106. 11–12, *pp.* 675–691, 1937.—Continuing earlier work [see Abstract 1286 (1934)] it is stated that below a characteristic temperature every metal may be converted to the amorphous state exhibiting properties fundamentally different from those of the crystalline metal. Heating above this transformation temperature causes a sudden change in properties as the amorphous metal recrystallises. The principal difficulties in the production of the amorphous modification are discussed and the advantages and disadvantages of the different methods are set forth. The transformation-temperatures for the metals successfully prepared in the amorphous state are given and it is concluded that the conversion of all metals into the amorphous form is only a question of developing the correct experimental technique. [See following Abstract.] A. G. Q.

**4804. Structure of Thin Metal Films. J. Kramer.** *Zeits. f. Physik*, 106. 11–12. *pp.* 692–701, 1937.—In sufficiently thin layers the amorphous modification of every metal [see preceding Abstract] may be produced even above the transformation temperature $T_w$ which is found to be a constant for thicker films. The transformation temperature is dependent upon the film-thickness when this is less than a well-defined minimum value, and lies between $T_w$ and the ionisation temperature of the metal atoms in the vapour phase. Moreover, the actual transformation temperature varies with the distance from the surface of the metal layer, being higher at the surface than in the interior. It is concluded that the transformation temperature at the surface of a normal metal may be so high as to render the production of an amorphous layer possible at room-temperature. A. G. Q.

**4805. Electron Diffraction and Surface Structure. G. I. Finch.** *Roy. Inst., Proc.* 29. 4. *pp.* 601–606, 1937.—After an introductory discussion of the dual wave and corpuscular nature of electrons, the author deals with the results obtained by applying electron diffraction to the study of the Beilby layer. The "running-in" of an engine is shown to consist in the production of a hard, tough, amorphous Beilby layer on the bearing surfaces, with consequent distribution of the load over a considerably greater area. Excessive cylinder wear due to the use of Al pistons is attributed to the fact that the freshly formed amorphous oxide film on Al recrystallises after polishing to form sapphire, and it is suggested that the use of a thin coating of Al-Mg alloy on the pistons should lead to reduced wear since spinel, a solid solution of aluminium oxide in magnesium aluminate, forms a permanently amorphous Beilby layer on polishing. A. G. Q.

**4806. Electron Diffraction and Surface Structure. G. I. Finch and H. Wilman.** *Ergeb. d. exakt. Naturwiss.* 16. *pp.* 353–436, 1937. *In English.*—After an historical introduction, a critical survey of the mathematical treatment of the scattering of fast electrons is given and the results of theory compared with those of experiment. Thus, whilst theoretical considerations lead to the conclusion that under suitable conditions 15% of a beam of 130-kV electrons may be polarised, only negative results have so far been obtained experimentally. The intensity of scattering of electrons by atoms is shown to be of the order of $10^6$ times that of X-rays and this, combined with the much greater efficiency of generation of the electron beam, results in the very short exposure times necessary with electrons. Modern equipment for electron diffraction is described, and the methods for the preparation of specimens previously given [see Abstract 4074 (1935)] are supplemented. Interpretation of electron diffraction patterns classified under (*a*) single crystal transmission, (*b*) reflection from single crystals, (*c*) transmission through polycrystalline films, and (*d*) reflection from polycrystalline surfaces, is fully dealt with and the pseudo-cross-grating nature of electron diffraction ring patterns is emphasised. Results obtained by applying electron diffraction to the study of metal films and surfaces and of the polish layer are given in detail, and the wide field in which the method is being employed is indicated. A detailed Bibliography is given. A. G. Q.

***4807. Crystal Chemistry of Univalent Nitrate Ions. Part II. C. Finbak and O. Hassel.** *Zeits. f. phys. Chem.* 37. *Abt.B.* 1–2. *pp.* 75–80, 1937.—A description is given of an X-ray spectrograph with which either powder specimens or single crystals can be examined at high and at low temperatures. The camera is used to investigate the structure of $KNO_3$, $RbNO_3$ and $CsNO_3$. Details are given of the atomic positions in the case of the rhombohedral modification of $KNO_3$ which has the following unit cell dimensions: $a = 6{\cdot}835$ Å, $\alpha = 46° 48'$. [For Part I see Abstract 3353 (1937).] J. I.

**4808. Crystal Chemistry of Univalent Nitrate Ions. Part III. C. Finbak, O. Hassel and L. C. Strømme.** *Zeits. f. phys. Chem.* 37. *Abt.B.* 5–6. *pp.* 468–471, 1937.—The authors review the existing data on the structure of nitrate ions in many alkali nitrate crystals, and discuss the general structural relations. An X-ray investigation of the high temperature trigonal form of $RbNO_3$ shows that the hexagonal axes $a$ and $c$ are 5·48 Å and 10·71 Å respectively, hence the rhomb containing one $RbNO_3$ molecule has dimensions $r = 4{\cdot}77$ Å, $\alpha = 70° 10'$. [See preceding Abstract.] J. I.

**4809. Change from Amorphous to Crystalline Carbon. M. Çelebi.** *Zeits. f. Physik*, 106. 11–12. *pp.* 702–708, 1937.—An amorphous C is reported having a conductivity $2{\cdot}5 \times 10^{10}$ times smaller than the smallest value hitherto obtained. Crystallisation begins at about 600° C. and is accompanied by a sudden increase in the conductivity. It is stated that the amorphous carbon is remarkable in that current can only be passed when a reproducible, minimum field-strength is applied, and an analogy is made with the passage of a spark between electrodes in air. A. G. Q.

**4810. Polymorphic Transitions of 35 Substances to 50,000 kg./cm.² P. W. Bridgman.** *Am. Acad., Proc.* 72. 2. *pp.* 45–136, *July*, 1937.—A preliminary report [see Abstract 2905 (1937)] is amplified by a detailed account, with data and graphs, for the 35 substances: $Cu_2I_2$, AgCl, AgBr, $Ag_2S$, $ZnBr_2$, $HgCl_2$, $HgBr_2$, $HgI_2$, $GeI_2$, $PbI_2$, $Cr_2O_3$, KCN, AgCN, $NaNO_2$, $AgNO_2$, $RbNO_3$, $CsNO_3$, $AgNO_3$, $NaClO_3$, $NaBrO_3$, $NaClO_4$, $NaIO_4$, $KClO_3$, $KIO_4$, $RbClO_4$, $AgIO_3$, $AgClO_4$, $CsClO_4$, $CsIO_4$, $TlClO_4$, $NH_4ClO_4$, $Na_2SO_4$, $KMnO_4$, $CsMnO_4$, and $Pb(C_2H_3O_2)_2$. 61 substances, dealt with in the paper, gave negative results. N. M. B.

**4811. Differentiation of Micas by X-Ray Powder Photographs. G. Nagelschmidt.** *Zeits. f. Krist.* 97. 6. *pp.* 514–521, 1937. *In English.* —X-ray powder photographs of eight different micas, including two lithium micas and sericite are recorded. They are all found to belong to either of two types, the muscovite and the phlogopite-biotite type. The differences between the two types and the deviations from them are noted, and the bearing of this work on the interpretation of X-ray diagrams of soil colloids is pointed out. AUTHOR.

**4812. Lattice Constants of Alums with Light and Heavy Water of Crystallisation. E. Saur.** *Zeits. f. Krist.* 97. 6. *pp.* 523–525, 1937.—By means of back-scattering X-ray photographs it is shown that the lattice constants of $KCr(SO_4)_2$ and $KAl(SO_4)_2$ with a mixture of light and heavy water of crystallisation are the same as for the normal hydrated salts. It is pointed out, however, that the results do not prove that the distances of the $H_2O$ and $D_2O$ molecules from the metal atoms are equal. Slight variations in the positions of the water molecules would only cause exceedingly small changes in the lattice constants, and more accurate determinations are necessary before a definite conclusion may be drawn. A. G. Q.

**4813. Structure of Compounds of Rare Earths. A. Iandelli and E. Botti.** *Accad. Lincei, Atti*, 25. *pp.* 638–640, *June* 4, 1937.—Four compounds of Nd were examined by the method of powders. For NdN, NdP, and NdSb the K-radiation of Cu was employed, for NdAs the K-radiation of Fe was used. The results are given in tables. [See Abstract 4292 (1937).] J. J. S.

**4814. Structure of Solid $H_2O_2$. F. Fehér and F. Klötzer.** *Zeits. f. Elecktrochem.* 43. *pp.* 822–826, *Oct.*, 1937.—Single crystals of $H_2O_2$ are obtained by crystallising an aqueous solution in a specially constructed apparatus. The crystals are tetragonal with the following unit cell dimensions, $a = 4\cdot02$, $c = 8\cdot02$ Å, probable space-group $= D_{2d}^1$ or $D_{2d}^5$. J. I.

**4815. Crystal Forms of Complex Salts of Triaminopropane with Trivalent Cobalt and Rhodium. P. Terpstra and J. ter Berg.** *K. Akad. Amsterdam, Proc.* 40. 7. *pp.* 602–606, 1937.—The authors record the results of a crystallographic study of some complex salts of $CH_2(NH_2).CH(NH_2).CH_2(NH_2)$ of the general type $\{Me(t^{pn})_2\}\chi_3$, where Me $=$ $Co^{\cdots}$ or $Rh^{\cdots}$ and $\chi = $ Cl, Br, I or SCN. J. I.

**4816. Structure of *p*-Dichlorobenzene at Different Temperatures. S. C. Sirkar and J. Gupta.** *Indian Journ. Phys.* 11. *pp.* 283–288, *Sept.*, 1937.—Two Laue patterns of a single crystal of *p*-dichlorobenzene mounted with its 100 face approximately normal to the X-rays have been photographed, one with the crystal kept at a temperature just above 37° C. and in the case of the other crystal being cooled and kept below 20° C. The two Laue patterns are observed to be identical. No evidence is, therefore, obtained of the transformation from α to β-modification which Vuks has recently reported [see Abstract 2240 (1936)] to have observed by raising the temperature of these crystals just above 32° C., while studying their Raman spectra. AUTHORS.

**4817. X-Ray Analysis of Dibenzyl Series. Part IV. Detailed Structure of Stilbene. J. M. Robertson and Ida Woodward.** *Roy. Soc., Proc.* 162*A*. *pp.* 568–583, *Oct.* 15, 1937.—The detailed structure of stilbene has been deduced from intensity measurements on the crystal by successive approximations involving double Fourier syntheses of the $(h0l)$ zone of structure factors. The molecules are shown to be nearly planar and may be exactly planar within the limits of experimental error. This planar form is in striking contrast to the shape of the dibenzyl molecule in the crystal, where the benzene rings are almost at right angles to the plane of the central zigzag. The planar form of the stilbene molecule is explained by the conjugation of the central double bond with the benzene rings, and the consequent contribution which an alternative excited structure makes to the normal state. The resonance involved is also shown by the thermochemical data and by the internuclear carbon-carbon distances obtained from the analysis, the " single bonds " emerging from the benzene rings having a length of only about 1·44 Å. The length of the double bond is about 1·33 Å, although this is not a very direct determination owing to difficulties in the analysis. Two stilbene molecules contribute to the asymmetric unit of the crystal, and although these molecules have different appearances in the electron density maps the differences are shown to be due to the relative orientation of the molecules and not to any appreciable differences in their shape or dimensions. The precise orientation of each molecule is given, with the coordinates of the atoms. The minimum intermolecular approach distances are of the order of 3·5 Å, similar to the distances found in other aromatic hydrocarbons. [For Part III see Abstract **1432** (**1936**).] AUTHORS.

***4818. Structure Determination of Organic Compounds. H. Mark and F. Schossberger.** *Ergeb. d. exakt. Naturwiss.* **16.** *pp.* **183–236,** 1937.—The authors give a very comprehensive survey of the various methods and apparatus which are used to investigate the structure of organic compounds. In Part I the authors describe the experimental methods and apparatus used to obtain X-ray photographs. A table gives the particular advantages of each method for the various types of problems. In Part II the factors which influence the observed intensity of X-ray reflection are discussed. Part III is a brief statement of the sequence of steps in a complete structure determination. Part IV is a description of methods and apparatus for measuring the intensity of X-ray reflections, and Part V describes the use of the measured intensities of reflections to determine the atomic parameters in a crystal lattice. In Part VI (*pp.* **210–234**) examples are given of the results which have been obtained for the various types of organic compounds including aromatic, aliphatic and fibrous substances. J. I.

**4819. Fluctuation Phenomena in Liquid Crystals. H. Tropper.** *Ann. d. Physik,* **30. 4.** *pp.* **371–387,** *Oct.,* **1937.**—The Mauguin scintillation phenomenon has been quantitatively investigated in the anisotropic phase of *p*-acetoxybenzalazin, a thin layer of the substance being examined between crossed Nicol prisms by a micro-kinematographic apparatus at different temperatures and various strengths of a magnetic field whose lines of force were parallel to the direction of observation. The micro-photographs were statistically worked up for different view points. By this means the distribution function of the transmissions which prevail at different places of the field of view at the same time, and the scattering, have been evaluated in relationship to temperature and field-strength. Further, the dimensional order of the spatial transmission fluctuations and the time-intervals of the temporary fluctuations have been investigated at one and the same spot of the field of vision. All the observed phenomena may be explained adequately on the basis of the swarm theory of liquid crystals as opposed to Zocher's standpoint [see Abstract **2991** (**1936**)]. Accordingly the scintillation phenomena are to be regarded as a result of the thermal rotational fluctuations of the molecular swarms. H. H. Ho.

**4820. Swarm Theory of Liquid Crystals. R. Fürth and K. Sitte.** *Ann. d. Physik,* **30. 4.** *pp.* **388–400,** *Oct.,* **1937.**—It is shown that the continuum and swarm theories proposed by different investigators to explain liquid-crystal phenomena are not actually in opposition, but fit into each other when the swarm dimensions are small with respect to the microscopic observation of accessible dimensions but large with respect to the definition of the macroscopic field magnitudes, *i.e.,* about the dimensional order of the wave-lengths of visible light. General arguments are advanced for the existence of swarms in liquid-crystal substances, and it is shown that the mathematical treatment of the continuum theory is also applicable in the swarm theory, and that the fundamental differential equation derived therefrom is free from the objections which can be raised against the alternative method. Four independent methods are shown to give values for the swarm diameter which agree excellently. the methods being based on the earlier measurements of the dielectric constants of liquid crystals and the recent data of Tropper on the Mauguin scintillation effect. The data of the swarm theory, which take into account thermal fluctuations, are shown to be more valid than the corresponding results from the continuum theory. H. H. Ho.

**4821. Liquid-Crystal and Solid Forms of Ethyl Anisylidene-p-Amino-Cinnamate. D. Vorländer, R. Wilke, H. Hempel, U. Haberland and J. Fischer.** *Zeits. f. Krist.* 97. 6. *pp.* 485–503, 1937.—The production of the above compound is fully described. The various liquid-crystalline phases observed on heating the solid from approximately 83° C. to 139° C. have been examined microscopically. On cooling from 139° C., at which temperature the compound is truly liquid, to 83°–85° when it is solid there appear 3 liquid-crystal phases, the three reversible transition temperatures being 139° C. (liq.—liq.-cryst. I), 118° C. (liq.-cryst. II—liq.-cryst. III), respectively. At 83°–85° C. the liquid-crystal phase III becomes solid in a tabular crystalline form, a reversible transition, but if phase III cools to a second solid phase (fibres or plates) this phase changes on heating to 106° C. to phase II, an irreversible change. J. I.

**4822. Dehydration Nuclei on $CuSO_4$, $5H_2O$ Crystals. W. E. Garner and H. V. Pike.** *Chem. Soc., J. pp.* 1565–1568, *Sept.*, 1937.—The shapes of the dehydration nuclei formed on nine faces of crystals of $CuSO_4$, $5H_2O$ have been studied, and it is shown that dehydration occurs most rapidly along definite crystal planes. The 010 plane is the most important of these, and possible causes of the rapid dehydration along this plane are discussed in the light of the X-ray structure of the salt as determined by Beevers and Lipson [see Abstract 4413 (1934)]. AUTHORS.

**4823. Crystallisation of Amorphous Selenium. J. A. Prins and W. Dekeyser.** *Physica,* 4. *pp.* 900–908, *Oct.*, 1937. *In French.*—Transmission photographs of amorphous Se stretched at temperatures 60°–70° show a fibre diagram of the well-known crystalline structure. The fibre axis is the hexagonal axis. It coincides with the direction of force. Reflection photographs of amorphous Se tempered at different temperatures show no crystallisation below 72° and a crystallisation increasing with duration of tempering above 73°. The degree of crystallisation decreases with depth. It is assumed that the crystallisation is favoured by the stress existing in the surface layer in consequence of the way the specimens were prepared (quenching). This may also account for the curious fact that at incipient crystallisation only the two longest spacings, due to planes of densest population, occur as sharp lines superposed on the amorphous pattern, whereas the other lines appear much later and in a more diffuse way. The second fact is favourable to and the first one is opposed to the idea of a continuous transition from the glassy state to the crystalline state. AUTHORS.

**4824. Elastic Limit of Aluminium Rod. M. Sugihara.** *Kyoto Coll. Sci., Mem.* 20. *pp.* 173–178, *July,* 1937. *In English.*—The limit of elasticity of an Al rod composed of a single crystal scarcely varies with the difference of the orientation of the crystal. In the case of rods composed of comparatively large crystals, the limit of elasticity decreases rapidly with the increase of the linear crystal size, but after exceeding

the crystal size of about 0·3 cm., it decreases very slowly. For the determination of the elastic limit of a rod composed of a large crystal, the method of gradually increasing loads is preferable to that in which the load is applied and removed repeatedly. [See also Abstract 4309 (1937)].
AUTHOR.

**4825. Plastic Deformation of Rock-Salt. N. A. Brilliantow and I. W. Obreimow.** *Phys. Zeits. d. Sowjetunion,* 12. 1. *pp.* 7–19, 1937. *In English.*—In this report a method is described of obtaining big twins of rock salt crystals. The optical and X-ray measurements of angles between the twins show that translation (gliding) is absent. The experiments described show that in the deformation of a rock-salt crystal the birefringent stripe is the boundary between the twins, and that this boundary is coloured with X-rays more intensely than other places of the crystal. [See Abstract 1375 (1935)]. AUTHORS.

***4826. Precision Determination of Linear and Angular Constants of Single Crystals. M. J. Buerger.** *Zeits. f. Krist.* 97. 6. *pp.* 433–468, 1937. *In English.*—An apparatus is described in detail that requires only a small single crystal. It has symmetrical back-reflection Weissenberg characteristics, the X-ray beam entering through the centre of the Weissenberg film, the satisfactory behaviour of which is assured by its translation range being reduced to about 25 mm. Full details of the working with relevant tables are given. In this way the interplanar spacings, interfacial angles and linear and angular lattice constants of both reciprocal and direct lattices can be determined with great accuracy—a few seconds in the case of angles—for crystals of any system. C. A. S.

***4827. Gnomonic Ruler. G. L. Clark and S. T. Gross.** *Science,* 85. *pp.* 272–273, *Sept.* 17, 1937.—A simple device is described for obtaining a gnomonic projection from a Laue pattern. The ruler consists of a plate mounted on the Laue pattern so that a straight edge passes through the centre of the pattern. At a fixed distance from the centre a bearing carries a movable part with two arms arranged so that when a Laue spot is at the intersection of one arm and the straight edge the projection point is indicated by the intersection of the other arm and the straight edge. J. I.

*See also* Abstracts 4777, 4789, 4790, 4791, 4792, 4793, 4949, 4977, 5013, 5022, 5082, 5101, 5102, 5103, 5106, 5108, 5109.

## DENSITY.

**4828. Distribution of Heavy Water in Salt Hydrates. J. S. Anderson, R. H. Purcell, T. G. Pearson, A. King, F. W. James, H. J. Emeléus, and H. V. A. Briscoe.** *Chem. Soc., J. pp.* 1492–1501, *Sept.*, 1937.—The flotation method of comparing liquid densities previously described [see Abstract 3985 (1934)], has been refined by the use of smaller silica floats and concomitant changes in the technique of purifying samples and observing the flotation temperature so that comparisons with an error not exceeding $\pm 0{\cdot}2\gamma^4$ are made with 2–5 c.c. of water obtained from an original sample of about 10 c.c. Temperature control of the thermostat has been improved by using a relatively small mercury regulator controlling the heater current by means of a valve-operated relay circuit. A rapid method for density comparisons within $\pm 2{\cdot}0\gamma^4$ is also described. These methods have been applied to additional survey experiments, especially on waters from cancer tissues, in the study of certain salt hydrates, and in examining the interchange between heavy water and certain amines and cobaltammines.

## DIFFUSION AND OSMOSIS.

**4829. Diffusion of Pairs of Gases with Molecules of Equal Mass. L. E. Boardman and N. E. Wild.** *Roy. Soc., Proc.* 162*A*. *pp*. 511–520, *Oct.* 15, 1937.—Diffusion experiments were carried out with the two pairs of gases, $N_2$-CO and $N_2O$-$CO_2$. Previous experiments have shown that each pair consists of two gases whose physical properties are almost exactly the same. The diffusion experiments made with these pairs of gases are, therefore, from the point of view of the classical kinetic theory, a close approximation to self-diffusion. The coefficients of self-diffusion for $N_2$ and for $CO_2$ were also calculated from experiments on the pairs of gases: $H_2$-$CO_2$, $N_2$-$N_2$, and $N_2$-$CO_2$. There is good agreement between the coefficients obtained by the two methods. The result is not contrary to the conclusions reached in the quantum theory of collisions of Massey and Mohr, as from that point of view it is necessary for the molecules in true self-diffusion to be identical and indistinguishable. AUTHORS

**4830. Theory of Osmotic Pressure. A. Thiel.** *Zeits. f. phys. Chem.* 180. *Abt.A.* 4. *pp*. 314–316, 1937.—Wohl's considerations [see Abstract 2930 (1937)] with respect to the connection between osmotic pressure, vapour pressure and atmosphere-effect have been recognised as valid for the case of ideal solutions. In general, however, the under-pressure definition of osmotic pressure has been retained, since here a complicating influence of the osmotic pressure by compression of the solution may be omitted. The Ulmann diaphragm is found to be no model of a semipermeable membrane. A simple derivation of the van't Hoff law is given from the general equation of the osmotic pressure for the case of sufficiently dilute solutions. H. H. Ho.

## ELASTICITY AND PLASTICITY.

**4831. Stress Systems in a Disc under Radial Forces. R. D. Mindlin.** *J. of Applied Mechanics*, 4. *A*115–*A*118, *Sept.*, 1937.—The transformation of inversion is employed to generalise a particular solution obtained by Michell for plane stress in a disc. The transformation is rendered difficult by the presence of a singularity in the interior of the disc at the point of application of the force. In the inversion of plane stress in a multiply-connected plate, the displacement functions for the transformed state are not necessarily single-valued even though they may have arisen from single-valued displacements in the original plate. This difficulty is overcome by the introduction of suitable functions. E. H. D.

**4832. Graphical Computation of Stresses from Strain Data. A. H. Stang and M. Greenspan.** *Bureau of Standards, J. of Research*, 19. *pp*. 437–441, *Oct.*, 1937.—The arithmetic involved in the use of the analytical solution for principal stresses in terms of strains on four intersecting gauge lines 45° apart is very tedious if these stresses are computed at many locations. This paper presents graphs which materially reduce the time and labour necessary for such computations. There are presented, also, graphs by means of which normal and shearing stresses on oblique planes are readily obtained from principal stresses. The use of the various graphs is illustrated by numerical examples. AUTHORS.

**4833. Elastic Stability of a Corrugated Plate under a Shearing Force. A. E. Green.** *Cambridge Phil. Soc., Proc.* 33. *pp*. 459–473, *Oct.*, 1937.—The problem is worked out on the assumptions that both the thickness of the plate and the depth of the corrugations are small compared with the wave-length, and that the length of the plate is so great that "end effects" may be neglected. Numerical results are given for a number of special cases, and these are compared with the results of Leggett [see Abstract 4327 (1937)]. W. G. B.

**4834. Theory of Elasticity for Contours with Angular Points. L. Magnaradze.** *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 16. 3. *pp.* 149–153, 1937. *In French.*—Two-dimensional problems (given the stresses or the displacements along the boundary) can be reduced to the determination of two functions of a complex variable by means of integral equations of the Fredholm type. When the boundary has angular points some generalisation is necessary, and this is carried out for the second class of problem. W. G. B.

***4835. Optical Strain Coefficient as Material Constant. A. V. Blom.** *Kolloid Zeits.* 80. *pp.* 212–215, *Aug.*, 1937.—A modification of the polarisation microscope is described which makes it independent of the azimuth of the Nicols. It is used to investigate the strain fields produced in colloidal polymeric materials by internal or external fields. The optical strain coefficient is recommended as a material constant which can be used in determining the molecular structure of polymeric substances. C. B. A.

**4836. Vibration. J. P. den Hartog.** *J. of Applied Mechanics*, 4. *A*136–*A*138, *Sept.*, 1937.—A Bibliography on the subject.

**4837. General Solution of Equations of Plane Vibrations. I. N. Vècoua.** *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 16. 3. *pp.* 155–160, 1937. *In French.*—It is shown that the general solution for free vibrations can be expressed in terms of functions of a complex variable, these functions being determined to satisfy integral equations of the Fredholm type. As an example, the period equation for the vibrations of a circular cylinder in planes perpendicular to the axis is obtained by these means. W. G. B.

*See also* Abstracts 5036, 5037.

## GRAVITATION.

*See* Abstracts 4889, 4890.

## HYDRODYNAMICS AND AERODYNAMICS.

**4838. Vortical Rings that Generalise the Bénard-Kármán Scheme of Hydraulic Resistance. G. Lampariello.** *Accad. Lincei, Atti*, 25. *pp.* 590–594, *June* 4, 1937.—A mathematical method is developed for the evaluation of the hydraulic resistance which opposes itself to the uniform translatory motion of a solid of revolution immersed in a perfect liquid, free from the action of forces of mass and movable in the direction of the axis of symmetry. J. J. S.

**4839. Two-Dimensional Potential Theory. Rosa M. Morris.** *Cambridge Phil. Soc., Proc.* 33. *pp.* 474–484, *Oct.*, 1937.—A general method for the solution of this class of problem for the region outside a cylinder is exemplified by its application to the solution of the following problems:—(i) a cylinder in a uniform field, (ii) a cylinder under the influence of a parallel line-charge, (iii) the effect of an intrinsic charge on the cylinder in cases (i) and (ii); and the hydrodynamical cases (iv) of a cylinder in a uniform stream, and (v) of a cylinder in motion in an infinite liquid (including translation and rotation). [See also Abstract 4341 (1937).] W. G. B.

**4840. Velocity Distribution in Turbulent Flow in Pipes. V. A. Gavrilenko.** *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 16. 3. *pp.* 161–164, 1937. *In English.*—In view of the comparison of the author's theory with experimental results for turbulent flow in a rectangular pipe [see Abstract **4342** (1937)], the basic assumption is altered so that the contribution of an element *ds* of the wetted perimeter to the velocity gradient at a point P is proportional to *ds*, instead of to the projection of *ds* on a plane at right-angles to the line joining *ds* and P. Formulæ based on the new assumption are given. S. G.

**4841. Transition to Turbulence in Pipe Flow. H. Hahnemann.** *Forsch. IngWes.* 8. *pp.* 226–237, *Sept.–Oct.*, 1937.—The experimental results of Naumann and Kurzweg concerning transition to turbulence in flow through a pipe were confirmed, and the experiments were extended to larger disturbances at the entry, to greater entry lengths, and to flow in a rough rectangular pipe. Kurzweg's criterion for transition to turbulence was $(Z/\nu)_{\text{crit.}} = 1170$, where Z is the "circulation in the disturbance for a length equal to the radius." This criterion is verified for sufficiently small disturbances at entry, such that the critical Reynolds number ($R_{\text{crit.}}$), referred to the radius and the mean velocity, is greater than 1600. When the entry disturbances are made larger, and $R_{\text{crit.}}$ falls from 1600 to 1160, $(Z/\nu)_{\text{crit.}}$ rises considerably. For no entry disturbances does $R_{\text{crit.}}$ fall below 1160, but on increasing the entry disturbances the value of $(Z/\nu)_{\text{crit.}}$ continues to increase, a value of $10^5$ being recorded in one instance. S. G.

**4842. Developments of the Theory of Turbulence. H. L. Dryden.** *J. of. Applied Mechanics*, 4. *A*105–*A*108, *Sept.*, 1937.—A brief account of the principal concepts utilised in the formation of theories of the turbulent motion of fluids prior to 1935 and the new approach originated by G. I. Taylor in that year [see Abstract 4101 (1935)]. A Bibliography of 31 papers is included. AUTHOR.

**4843. Flow Past a Flat Plate, to Oseen's Approximation. V. D. H. Rutland and W. G. Bickley.** *Phil. Mag.* 24. *pp.* 704–711, *Oct.*, 1937.—An exact solution of Oseen's equations for this case is obtained, using parabolic coordinates. The object is chiefly to examine the success of the Oseen approximation in a case which is not particularly favourable, by comparison with Blasius' solution of the boundary-layer equations. The results of the present analysis give a resistance coefficient about 70% too great, and the "thickness" of the boundary layer about 23% too small. In an attempt to obtain a second approximation, it appears that the main cause of the failure in accuracy is the omission in the Oseen equations of the term representing convection (of momentum or vorticity) across the stream. On the other hand, the present work gives a truer picture of affairs in the neighbourhood of the leading edge. W. G. B.

**4844. Disintegration of Liquid Jets. P. H. Schweitzer.** *J. of Applied Physics*, 8. *pp.* 513–521, *Aug.*, 1937.—The article summarises the researches of various investigators upon the atomisation of liquid jets *in vacuo*, and in air of various densities. In the light of this work the phenomenon of liquid jet disintegration is described. It is deduced that atomisation, in the sense of breaking up the spray into minute particles, could not be obtained without air friction; but to make this factor effective turbulence is essential, because a completely laminar jet has a non-moving skin when it leaves the nozzle. Of liquid properties, viscosity is recognised as having the decisive influence on jet disintegration. R. H. G.

*See also* Abstracts 4850, 4894.

## KINETIC THEORY OF MATTER.

*See* Abstracts 4829, 4994, 5017, 5018.

## MATHEMATICAL METHODS. THEORY OF MEASUREMENTS. UNITS AND DIMENSIONS.

**4845. "Converging Factor" in Asymptotic Series and the Calculation of Bessel, Laguerre and other Functions. J. R. Airey.** *Phil. Mag.* 24. *pp.* 521–552, *Oct.*, 1937.

**4846. Probability Experimentally Investigated. A. L. Clark.** *Canad. J. of Research*, 15. *Sect. A. pp.* 149–153, *Sept.*, 1937.—This paper is the third and last of a series [see Abstract 102 (1935)]. Steel balls were dropped on a horizontal steel plate in which holes were bored in a regular pattern. The probability that a ball will pass through a hole without touching the plate is calculated from the known data and found to be 0·3554 ± 0·0005. The experimental value of the probability or the ratio of free passages to the total number of balls dropped is 0·35557. The agreement is very good. The numbers of runs of various lengths were calculated and compared with the actual numbers of these runs, again with good agreement. $\pi$ may be calculated from the experimental value of the probability. AUTHOR.

**4847. Tests for Sampling Differences and Contingency. H. Jeffreys.** *Roy. Soc., Proc.* 162*A*. *pp.* 479–495, *Oct.* 15, 1937.—A mistake in two significance tests [see Abstract 4535 (1936)] is corrected; the difference between these appeared to be much more than could be accounted for by the difference in the experimental conditions considered, and is now almost entirely removed. The revision leads to a restatement of Ockham's principle for practical application, and to a discussion of the revision of prior probabilities as knowledge in a subject advances. AUTHOR.

**4848. Distributions Associated with a Randomly Arranged Set of Numbers. W. O. Kermack and A. G. McKendrick.** *Roy. Soc. Edinburgh, Proc.* 57. 3. *pp.* 332–376, 1937.—The following problems are discussed: Given a random series of numbers, certain of the numbers will be greater than their immediate neighbours, whilst others will be less. Each maximal number is succeeded by a "run down" to the succeeding minimal number, which, in turn, is succeeded by a run-up. It is required to find the value of $x_{nr}$, *i.e.*, the chance that a sequence of $r$ runs will contain $n$ numbers for all values of $n$ and $r$. Further it is required to evaluate $p_{\nu\rho}$, *i.e.*, the chance that $\nu$ successive numbers will contain $\rho$ runs. The problems are discussed, first for an infinite series of numbers, then for a finite series of unequal numbers, more especially for the case $r = 1$ or 2, and, finally, for a cyclic arrangement of numbers, *e.g.*, in the distribution of playing cards round a circular table. J. S. G. T.

∗**4849. Machines for Algebraic Calculations. L. Poggi.** *Ricerca Scientifica*, 8. *pp.* 300–303, *April, and pp.* 418–422, *May*, 1937.—A machine is described by which a graphical trace of a linear function of any degree can be obtained and from which the real roots appear. A diagram of the essential parts of the machine is given and the basis upon which it is built is explained. A particular case of the function $\sum_{1}^{n} a_m x^m + a_0$ for

$n = 4$ is taken as an example and the accuracy of the results discussed. A simple machine is also described for calculation of expressions of the type $X = \sum_{1}^{n} a_m y_m$. It consists essentially of rotating rods, pivots and sliding contacts; a diagram of the essential parts is shown and explained for $n = 4$. In the figure only pantographs with equal arms are used, but if the arms are unequal it is possible to sum any number of terms. The apparatus may be extended to solve equations of systems of higher order than that for which it is made. The degree of accuracy obtainable is considered. H. M. B.

*See also* Abstracts 4839, 4956, 5042, 5120.

## MECHANICS, CLASSICAL.

**4850. Mechanics of Sport. G. Walker.** *Nature,* 140. *pp.* 567–568, *Oct.* 2, 1937.—The effects of spin are referred to in curling, the path of a billiard ball, the arrow and spear, the use of the spear thrower and beckett, the flight of the boomerang, the use of the adze, the motion of human beings in the crawl stroke in swimming and the high jump, and of birds in sailing flight. R. S. R.

**4851. Stability of Motion in the Sense of Liapounoff. J. Malkin.** *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 15. 8. *pp.* 437–439, 1937. *In German.* W. G. B.

*See also* Abstract 4906.

## MECHANICS, QUANTUM.

**4852. Statistical Geometry and Quantum Electrodynamics. A. March.** *Zeits. f. Physik,* 107. 1–2. *p.* 144, 1937.—A correction. [See Abstract 3917 (1937).]

**4853. Approximate Wave Functions for the Helium Ground State. J. Solok.** *Phys. Zeits. d. Sowjetunion,* 12. 1. *pp.* 120–122, 1937. *In German.*—Using a method developed by Romberg, an approximate wave function is calculated for the ground state of He from a study of the minimum of the mean square errors. Comparison with other results shows that the method is quite accurate. G. O. B.

**4854. Equivalence of Two Dirac Systems. R. L. Gomes.** *Accad. Lincei, Atti,* 25. *pp.* 560–564, *June* 4, 1937. *In French.*—A new demonstration of equivalence, based on the properties of values of the fundamental vectors of a Dirac system, is presented. N. M. B.

**4855. Physics and Geometry. Y. Mimura and T. Hosokawa.** *Hirosima Journ. Sci.* 7. *pp.* 249–253, *Aug.*, 1937. *In English.*—A general discussion of the nature of geometry and its relation to the new geometry based on actual physical phenomena [see Abstract 1537 (1937)]. N. M. B.

**4856. Electromagnetism in Wave Geometry. T. Iwatsuki, Y. Mimura, and K. Morinaga.** *Hirosima Journ. Sci.* 7. *pp.* 255–257, *Aug.*, 1937.—*In English.* The theory of electromagnetism is propounded under the new geometrical principle, and it is shown that by the wave geometry thus established the unified field theory may be achieved. N. M. B.

**4857. New Foundation of Atomic Structure. Y. Mimura and T. Iwatsuki.** *Hirosima Journ. Sci.* 7. *pp.* 259–261, *Aug.*, 1937. *In English.*—Just as Bohr's atomic theory was developed on an analogy with Newton's theory of the solar system, so the rise of Einstein's field theory suggests that the theory of the atom can be developed in analogy with this field theory. The authors give an introductory discussion of this problem. It is subsequently shown [see following Abstract] that the atomic structure is in itself the construction of the space-time due to the nucleus. N. M. B.

**4858. Hydrogen Atom in Terms of Wave Geometry. K. Morinaga.** *Hirosima Journ. Sci.* 7. *pp.* 263–304, *Aug.*, 1937. *In English.*—The theory of the H atom is established deductively from the point of view of wave geometry. From the geometrical theory of gravitation and electromagnetism is introduced the fundamental equation for $\psi$ [see preceding Abstract], which is expected to characterise the space due to the nucleus of an atom, and, under the assumption that this equation is completely integrable, the field equation in the space due to the nucleus is obtained and the current gravitational and electromagnetic law is established. Finally, on solving $\psi$ from the fundamental equation it is shown that the theory thus established is adequate to explain the nature of the H atom. N. M. B.

*See also* Abstracts 4753, 4778, 4796, 4797, 4950, 4959, 5041, 5064, 5069.

## RELATIVITY AND ETHER.

**4859. Aspects of Relativity Theory. Part II. J. v. Weyssenhoff.** *Zeits. f. Physik*, 107. 1–2. *pp.* 64–72, 1937.—The circumstances differentiating space-time measurements in gravitational fields from those in a Galilean universe are briefly discussed. Contrary to a very widely held opinion, the author contends that for such measurements *rigid* rods are unessential and that a clock having any arbitrary motion does not, in general, indicate its own "eigen" time. Space-time measurements are differentiated into measurements of the first and second classes; those of the first class are made in fields devoid of acceleration and are conceptional only; measurements of the second class are made in gravitational fields and in such measurements the elastic properties of the measuring rods and clocks necessarily play their part. [For Part I see Abstract 3320 (1935).] J. S. G. T.

**4860. Deviation of Light by the Gravitational Field of the Sun. L. Hanni.** *Tohoku Math. J.* 43. *pp.* 277–298, *June*, 1937. *In German.*—An *ad hoc* method in flat space is suggested for calculating the deflection of light by the gravitational field of the sun. G. C. McV.

**4861. Deviation of Light by the Gravitational Field of a Star. G. A. Tikhov.** *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 16. 4. *pp.* 199–204, 1937. *In French.*—The very small changes in the apparent magnitude of a star, the light of which is seen after being deflected by the gravitational field of a second star, are calculated. G. C. McV.

**4862. Ring-Singularity in Born's Unitary Theory. Part II. B. S. M. Rao.** *Indian Acad. Sci., Proc.* 6*A*. *pp.* 129–134, *Aug.*, 1937.—The substitution of the Hoffmann-Infeld action-function for that of Born does not yield a correct representation of elementary particles by ring-singularities. The difficulties in explaining spin classically as suggested by Kramers are therefore still inherent in unitary field-theory. [For Part I see Abstract 5434 (1936)]. G. C. McV.

**4863. Unified Theory of Gravitation and Electromagnetism. J. Hély.** *Comptes Rendus*, 202. *pp.* 1659–1660, *May* 8, 1936, *and* 205. *pp.* 486–488, *Sept.* 13, 1937.—A unified field-theory in flat space-time is proposed according to which the gravitational and electromagnetic potentials at any point are related in the sense that each is associated with one of a pair of parallel four-dimensional vectors. The author deduces that a gravitational wave exists forming the connecting link between waves of electromagnetic radiation and photons. G. C. McV.

**4864. Aberration of Clocks and the Clock Paradox. H. E. Ives.** *J.O.S.A.* 27. *pp.* 305–309, *Sept.*, 1937.—Continuing the investigations of a previous paper [see Abstract 3922 (1937)] the problem of the change in setting of clocks transported over the same measured distance at different times when the velocity of the observing platform is different is investigated. The result is related to stellar aberration. The behaviour of separated and reunited clocks is investigated, and "the clock paradox" which arises from the supposition that only relative velocities are of significance is resolved by allowing for their motion relative to the ether. H. G. C.

**4865. Apparent Lengths and Times in Systems Experiencing Fitzgerald-Larmor-Lorentz Contractions. H. E. Ives.** *J.O.S.A.* 27. *pp.* 310–313, *Sept.*, 1937.—Measurements of lengths and times on relatively moving bodies in which light signals are not involved are investigated. If the velocities of the clocks and rods used on the observation platform are very small, the equations become similar to those of the length and frequency contractions with respect to the ether. The special theory of relativity is, in the light of this analysis, a structure built on this special case. H. G. C.

*See also* Abstracts 4855, 4858, 4957.

## SOLUTION.

**4866. Solubility Equation for a Pure Substance Forming a Solid Compound with the Solvent. J. Perreu.** *Comptes Rendus*, 205. *pp.* 43–45, *July* 5, 1937.—An equation derived by the author for solid hydrates in equilibrium with their aqueous solution and its vapour is extended to the system NaI-acetone from which, below 25° C, the compound $NaI.3C_3H_6O$ crystallises. L. V. C.

## SURFACE TENSION AND COHESION.

**4867. Collision of Two Oil Drops and the Stability of Non-Spherical Drops. Y. Ishida.** *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 725. *pp.* 233–262, *Sept.*, 1937.—The conditions for the sphericity of an oil drop are examined mathematically. When minute oil particles are produced by atomisation, 50% of them are spherical and remain so; 20% are prolate spheroids with minimum resisting surface and eccentricity approximately 0·886; this gradually decreases and they become spheres within ten minutes. The remaining 30% are shown to be stable oblate spheroids. For a given mass the drops assume a surface of least resistance. The occasional collision of two oppositely-charged particles of unequal sizes gives rise to a pear shape which becomes a sphere within ten minutes. The orientation of the bodies in the electrostatic field indicates that the electrons on non-spherical drops are localised at the poles. N. M. B.

**4868. Molecular Theory of Interfaces. Part II. M. Volmer and K. Neumann.** *Die Physik*, 5. 4. *pp.* 131–137, 1937.—A review dealing with liquid interfaces, interfaces at which solid phases are distributed, adsorption from solution, and at solid surfaces, adsorption of ions, and surface diffusion. [For Part I see Abstract 4714 (1933)]. A. J. M.

### VACUA, HIGH.

*4869. **High-Vacuum Gauges. F. M. Penning.** *Philips Techn. Rev.* 2. *pp.* 201–208, *July*, 1937.—The various principles for measuring high vacua are briefly discussed. Some new designs of gauge are described in detail, particularly those which are based on the characteristics of electric gas discharges. AUTHOR.

*4870. **Needle Valve for Vacuum Apparatus. W. v. Meyeren.** *Zeits. f. techn. Physik*, 18. 9. *p.* 281, 1937.—A needle valve of simple construction is described in which the screw motion of the needle is controlled by means of a conical glass tap. The needle construction is not new, but the advantage of the arrangement is that it is made of glass and may be sealed directly on to glass apparatus without the necessity for metal-glass seals. H. J. H. S.

### VISCOSITY, FRICTION AND LUBRICATION.

**4871. Viscosity of Air. W. V. Houston.** *Phys. Rev.* 52. *pp.* 751–757, *Oct.* 1, 1937.—The viscosity of air has been remeasured with the rotating cylinder apparatus used by Day and Bleakney. All of the constants have been redetermined, and especial attention has been given to the corrections to the simple theory. The value obtained at 22° C is $\eta$ = 1·8243 ± 0·0045 c.g.s. units. This raises the oil drop value of *e* to 4·796 e.s.u. It is shown in the Appendix that a correction must be applied for the opening between the suspended cylinder and the guard cylinders, and also a correction must be applied for the moment of inertia of the air carried around by the cylinder when determining its moment of inertia. Neglect of these corrections has introduced some additional uncertainty into other work. AUTHOR.

**4872. Effect of Pressure on Viscosity of Oils. R. B. Dow, M. R. Fenske, and H. E. Morgan.** *Indust. and Engin. Chem.* 29. *pp.* 1078–1080, *Sept.*, 1937.—Further studies on the viscosity of lubricating oils at high hydrostatic pressures, particularly on the effect of adding Paratone to a sample of California oil, and an investigation of the viscosity at high pressures of two chlorinated diphenyls which are of interest in chemical engineering. [See also Abstract 2453 (1937)].

*4873. **Drainage Error in Viscometry of Aqueous Solutions. G. Jones and R. E. Stauffer.** *Am. Chem. Soc., J.* 59. *pp.* 1630–1633, *Sept.*, 1937.—A form of apparatus is described which is suitable for measuring the drainage of liquids in viscometers and pipettes as a function of the time of outflow, the shape and size of the glass surface and the properties of the liquid. It is shown that for a given surface the volume of after-drainage multiplied by the time of outflow is a constant, and that this constant is proportional to the kinematic viscosity of the liquid. It is shown that incomplete drainage is not a serious source of error in the determination of the viscosity of aqueous solutions relative to that of pure water. AUTHORS.

# ASTRONOMY AND ASTROPHYSICS.

## ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

***4874. Projection Machine for Measurement of Astronomical Spectra. R. M. Petrie.** *Roy. Astron. Soc., Canada, J.* 31. *pp.* 289–294, *Sept.*, 1937.—This machine is designed to reduce eyestrain and promote efficiency of measurement, and to this end the operator should not look through an optical system to observe the spectrum and scale reading, which should be as nearly as possible in one plane. A diagram and a plate of the projection micrometer are given. A comparison of the probable errors indicates that the projection method yields results of the same degree of accuracy as those of the microscope micrometer, and there is much less fatigue in measurement [see Abstract 2839 (1933)]. A. S. D. M.

*See also* Abstract 4875.

## COMETS AND METEORS.

***4875. Meteor Photography. P. M. Millman.** *Roy. Astron. Soc., Canada. J.* 31. *pp.* 295–310, *Sept.*, 1937.—The best type of lens for photographing meteors is one giving a field of some 30° to 40° dia. in good focus, such as Zeiss Tessar or Voightlander Skopar, of aperture ratio F/4·5 and focal lengths of from 4″ to 10″. Plates, *not* films, should be used. A fixed camera is better than one driven. More important than direct meteor photography is that of the meteor spectra, since these reveal not only the substance of the meteors, but also atmospheric conditions at heights from 25 to 100 miles up. This needs in addition to the direct photographic lens, a prism rather larger than it with a refracting angle of about 30°. Advice is given on the focusing of the spectra, and on the adjustment of the camera to the thin edge of the prism; diagrams and plates are also given. A. S. D. M.

## COSMOGONY.

*See* Abstract 4876.

## NEBULÆ.

**4876. Galactic Rotation from Study of Planetary Nebulæ. L. Berman.** *Lick Observat., Bull. No.* 486. *pp.* 57–75, 1937.—Data regarding the known planetary nebulæ, now some 140 in number, are statistically analysed in order to study the galactic rotation. The planetaries are ultimately segregated by successive approximations into 5 homogeneous distance groups according to their distance from the sun. The galactic rotation effect exhibited by the radial velocities for the various distance groups yields dynamical constants agreeing well with those obtained from other sources. The different types of galactic objects are therefore supposed to participate in the galactic rotation as a single system. Interstellar absorption at λ4300 is calculated as 0·72 mag. per kiloparsec in the galactic plane. The spatial distribution of the planetaries reveals the half portion of a rough discoidal structure having a diameter of 28,000 parsecs and a thickness of 3,000 parsecs approximately, with the sun located at a point very nearly two-thirds of the radius of the system from the centre. A. Hu.

**4877. Photoelectric Magnitudes and Colours of Extra-Galactic Nebulæ. J. Stebbins and A. E. Whitford.** *Mt. Wilson Observat. Contrib. No.* 577. *Astrophys. J.* 86. *pp.* 247–273, *Oct.*, 1937.—The magnitudes of 165 extra-galactic nebulæ down to magnitude 15 have been measured with the photoelectric cell; of these, 112 have also been measured for colour. The magnitudes, based upon the Harvard visual system, are reduced to the international scale and give a correction of −0·1 to the photographic magnitudes of the Harvard Survey at magnitudes 11–13. The colours of the nebulæ are referred to the colour scale of dwarf stars. The nebulæ of Hubble's types E, Sa, and Sb are nearly uniform in colour; those of type Sc are more varied, owing presumably to the presence of giant stars. There is a residual colour excess for the nebulæ, $E = +0{\cdot}14$ mag. on the international scale, which is possibly due to selective absorption within the nebulæ themselves. There is no dependence of colour upon magnitude such as would be caused by selective absorption in inter-galactic space. From the colours of nebulæ, globular clusters and B stars, it is found that the ratio of selective to total space absorption is smaller in high than in low galactic latitude. The sun is assumed to be immersed in a dark layer of small selectivity near the galactic plane, while clouds of greater selectivity are present in nearly all directions along that plane, but not immediately about the sun. AUTHORS.

## PLANETS.

**4878. Recent Eclipse of the Ring of Saturn. M. Maggini.** *Ricerca Scientifica*, 8. *pp.* 185–195, *March*, 1937.—On the occasion of the eclipse of Saturn's ring in 1936–37 photoelectric measurements were made at Collurania of the light intensity of the ring, and visual observations made of the various phenomena that accompanied the eclipse. The photoelectric measurements demonstrate a progressive darkening of the surface of the ring and also a variation in colour, as if some external nebulosity enveloped the ring. The existence of the nebulosity is confirmed by the visual investigations. The existence of this rarefied matter, probably corpuscular, outside the plane of the ring, manifests itself by a selective absorption of the radiation reflected from the illuminated surface of the ring. C. J. B. C.

**4879. Photochemistry of Planetary Atmospheres. R. Wildt.** *Astrophys. J.* 86. *pp.* 321–336, *Oct.*, 1937.—All polyatomic molecules detected in planetary atmospheres are highly sensitive to u.v. solar radiation. Their photochemical decomposition must be followed by secondary chemical reactions, reuniting the products of dissociation, in order to maintain the observed stationary composition of the atmospheres. The stability of $CH_4$ and $CO_2$ is reasonably accounted for, but that of $NH_3$ remains unexplained at present. The existence of $CH_4$ and the failure to detect any other hydrocarbon indicate the presence of plenty of $H_2$ on the giant planets, and most probably there is no $CO$, $CO_2$ or $H_2S$ at their surfaces. Small amounts of sundry molecules, not observed so far, are certain to be formed in consequence of the photochemical processes, and eventually these compounds may be detected under favourable circumstances. AUTHOR.

**4880. Temperature of Venus. A. Adel.** *Astrophys. J.* 86. *pp.* 337–339, *Oct.*, 1937.—The distribution of intensity of absorption in the fine structure of the $CO_2$ bands in the spectrum of Venus provides an independent approach to the problem of the planet's temperature. The temperature of the surface appears to be greater than 50° C. AUTHOR.

## STARS.

**4881. Orbital Elements of ν Octantis. A. Colacevich.** *Accad. Lincei, Atti,* 26. *pp.* 7–13, *July,* 1937.

**4882. Orbit of Ar Aurigæ. W. E. Harper.** *Dominion Astrophys. Obs., Victoria, Publ.* 6. 19. *pp.* 311–316, 1937.—The first few spectrograms of this eclipsing binary, in which both component spectra are recorded, indicated that the true period was double that listed from photometric results. 35 single-prism spectrograms obtained at Victoria, on 29 of which both component spectra are measured, are made the basis of a determination of the orbital elements of which the principal ones are: $P = 4\cdot134581$ days, $e = 0\cdot009$, $\omega_1 = 42^\circ.5$, $\omega_2 = 222^\circ.5$, $V_0 = +25\cdot6$ km., $K_1 = 106\cdot5$ km., $K_2 = 120\cdot9$ km. The masses are $2\cdot68\odot$ and $2\cdot36\odot$. The spectrum is B9, and since only two or three lines are generally sufficiently well resolved for measurement the probable error of a plate is of the order of $\pm 4\cdot5$ km./sec. AUTHOR.

**4883. Stark Effect in Stellar Spectra. R. v. d. R. Woolley.** *Observatory,* 60. *pp.* 235–239, *Sept.,* 1937.—The author discusses the observational work of Williams [see Abstract 2598 (1936)] in the light of the theoretical results obtained by Pannekoek and Verwey [see Abstract 2893 (1935)]. The observed Balmer line contours in early-type stars agree quantitatively with those predicted when Stark broadening is taken into account. The variation of total absorption along the Balmer series, and the variation of line width with temperature and surface gravity also agree with theory. The high central intensities are, however, not explained; fluorescence may play a part here. Balmer contours computed for the sun are in poor agreement with those observed: all that can be said is that there is an improvement over a theory which neglects Stark effect. The author attributes the failure here to an unjustified extrapolation of Kramers' theory from early-type to G-type stars. Nevertheless, a theory incorporating Stark effect accounts qualitatively for the behaviour of H and He lines in stellar spectra except for the high central intensities of the H lines. A. Hu.

**4884. Intensities and Displacements of Interstellar Lines. P. W. Merrill, R. F. Sanford, O. C. Wilson, and Cora G. Burwell.** *Mt. Wilson Observat., Contrib. No.* 576. *Astrophys. J.* 86. *pp.* 274–310, *Oct.,* 1937.—The main purpose of this contribution is to record measurements of the intensities and displacements of the interstellar lines D1, D2, H, and K in the spectra of numerous early-type stars. Intensities of the unidentified lines λλ 5780, 5797, and 6284 are included. Observational methods and the technique of measurement are fully described, and the accuracy of the results is discussed. Comparison of the Mount Wilson values of the intensities of the D lines with those of Beals indicates a fairly small accidental error in both series but a considerable systematic difference between them. Displacements of the D lines measured at various observatories are in good agreement. A catalogue is given including 254 stars brighter than apparent magnitude 7·0, 147 fainter stars, and, in addition, 3 Novæ. The numbers of objects with the various kinds of data are as follows:

| | | Ca | Na | λ6284 |
|---|---|---|---|---|
| Displacement | | 174 | 264 | .. |
| Intensity | measured | 114 | 213 | 129 |
| | estimated | 89 | 107 | .. |

A list of stars with especially strong interstellar lines is also given.

AUTHORS.

**4885. Light Curves for Three Variables with Peculiar Spectra. Naomi K. Greenstein.** *Harvard Coll. Obs., Bull. No.* 906. *pp.* 3–6, *Aug.* 1, 1937.—(1) *Z. Andromedæ.* Photographic observations from 1922–1936 are plotted with the previous magnitudes (now revised) from 1887–1922. The star seems to pass through intervals of great activitiy followed by quieter periods, one of which seems now ending. It becomes definitely bluer as it reaches maximum and redder towards minimum; it may be a system of a variable red star (band spectra near minima), and a blue Nova-like variable (bright line spectra near maxima), resembling R Aquarii. (2) *C. I. Cygni* is similar to *Z. Andromedæ.* A light curve is plotted from 364 plates for years 1890–1936, showing that it fluctuates irregularly. (3) *S. Y. Muscæ.* Its variation (1898–1935) is very regular and shows no sudden outbursts. The period of 623·1 seems exact; the range is 0·11. This small range and general regularity are unexpected in a star of so long a period and peculiar spectrum. A. S. D. M.

*See also* Abstracts 4874, 4966.

## SUN.

**4886. Eruptive Prominence of May 29, 1937. M. G. Fracastoro.** *Accad. Lincei, Atti,* 25. *pp.* 710–713, *June* 20, 1937.—At Arcetri on May 29th, 1937, a solar prominence was observed which rose with exceptional violence and attained in a few hours a height of about one-third of the solar diameter. A record of the observations made is given, and also some data from Zurich relating to the same prominence. The observations at Arcetri commenced at 8 hr. 18 min. when the protuberance had the appearance of a plume of feathers. At 8 hr. 24 m. it divided into two parts of which the upper moved rapidly away and became invisible after 8 hr. 32 min. Pettit from observations on prominences has deduced two general laws: (1) that the ascensional motion is uniform but undergoes sharp increments; (2) that the succeeding V is a whole multiple of the preceding velocity of rising. The prominence observed confirms Pettit's first law, but gives no clear result as to the second. J. J. S.

*See also* Abstracts 5124, 5125.

# GEOPHYSICS.

## GEODESY.

**4887. Deviations of the Vertical and Gravimetric Anomalies. G. Boaga.** *Accad. Lincei, Atti,* 25. *pp.* 714–719, *June* 20, 1937.—A mathematical paper in which it is explained, starting from the relations found by Pizzetti, how it is possible to obtain simple and elegant formulæ between the divergence of the ellipsoid of reference and the geoid (supposed of rotation), the deviations from the vertical in latitude, and the gravimetric anomalies. J. J. S.

**4888. Solution of N. Moisseiev's Integral Equation in the Theory of the Non-Regular Geoid Figure. B. Saltykov.** *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 16. 3. *pp.* 133–140, 1937. *In German.*—Reference is made to the equation derived earlier [see Abstract 4472 (1934)] to determine the figure of the geoid of an irregular earth. A solution of this equation is given and values are tabulated for the necessary functions for values of $\phi$ ranging from 0° to 180°. In the second part a new form of Moisseiev's equation for the figure of the irregular geoid is derived, and is called a quasi-Stokes equation. R. S. R.

**4889. Deviations from the Vertical and Gravity Anomalies. N. K. Mihal.** *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 16. 3. *pp.* 169–171, 1937. *In German.*—The formula derived earlier [see Abstract 4410 (1937)] is used where the double integral is replaced by a surface integral of the form $N = (R^2/4\pi\,\phi)\int(\partial\Delta g/\partial s)\cdot(H(\phi)/\sin\phi)\cdot d\sigma$, where $d\sigma$ is an element of the surface of a unit sphere. To obtain the deviation of the vertical in the meridional surface, expressions are obtained for $\partial N/\partial\phi$ and $\partial N/\partial\lambda$, where $\phi$ and $\lambda$ are the geographical coordinates of the point where the deviation of the vertical is determined. R. S. R.

## GEOPHYSICS, APPLIED.

***4890. Use of Eötvös Balance. G. Boaga.** *Com. Geod. e Geofis., Boll.* 7. *pp.* 1–18, *Jan.–April,* 1937.—By Eötvös measurements along two axes the mass, depth and dimensions of a spherical disturbing body may be determined. The method can be extended to bodies of other geometrical forms. Gravimetric anomalies may be used to control results obtained by other methods. W. A. R.

**4891. Geophysical Prospecting for Gold. A. Belluigi.** *Com. Geod. e Geofis., Boll.* 7. *pp.* 85–94, *Jan.–April,* 1937.—Some examples of methods of geophysical prospecting applied to auriferous deposits are described. W. A. R.

**4892. Measurement of Angles by Fractional Repetition. C. Schmerber, P. Tardi and P. Caillol.** *Comptes Rendus,* 205. *pp.* 514–516, *Sept.* 20, 1937.—Of the two classical methods, repetition and reiteration, the former was discontinued on account of the difficulty of constructing apparatus to give the greater accuracy required. A new process with a modern reiterator is described which has almost all the advantages of the earlier method, and the results of pairs of values obtained during the course of a field survey are given. R. S. R.

## HYDROSPHERE, PHYSICS OF THE.

**4893. Breaking Waves. P. Pétry.** *Comptes Rendus.* 205, *pp.* 483–484, *Sept.* 13, 1937.—The results obtained [see Abstract 4415 (1937)] are discussed. The highest pressures and velocities resulted when the wave on breaking curled over from the foot of the ramp (that being bare at the time), and compressed within the curl much air. In general, the air caught in and compressed by the breaking waves is responsible for much of the destructive effect. C. A. S.

**4894. Suspension of Solids in a Turbulent Stream. E. G. Richardson.** *Roy. Soc., Proc.* 162*A*. *pp.* 583–597, *Oct.* 15, 1937.—It is shown how the concept of an "*austausch* coefficient" in problems involving the diffusion of turbulence may be applied to the study of the distribution of solid material in a turbulent stream. A technique is developed by means of which the relative quantities of solid carried in suspension at different levels in a water channel having a bed of graded sand can be measured, and the results applied to predict how the *austausch* varies in the vicinity of the bed. The factor in question is found to increase in direct proportion to height at first but rapidly reaches a constant value in the main stream. Measurements in a natural river also indicate an approximately constant value, and, making this assumption of constant *austausch*, it is shown that a simple apparatus enables one to make observations of the total silt content of a river from time to time. AUTHOR.

## LAND, PHYSICS OF THE.

**4895. Electromagnetic Method for Testing Rock Samples. A. G. McNish.** *Terr. Mag.* 42. *pp.* 283–284, *Sept.*, 1937.—The particles of a magnetic precipitate allowed to settle in a magnetic field align themselves so that the sediment is magnetised in the direction of that field; also a magnetic substance cooling in such a field from a temperature above its Curie point becomes magnetised in the direction of the field. The possibility of deducing the magnetic history of the earth in past time by determining the direction and strength of magnetisation of various rocks and sediments is pointed out, and methods are suggested for such determinations. C. A. S.

*See also* Abstract 4811.

## METEOROLOGY.

**4896. Temperature and Constituents of the Upper Atmosphere. E. Kidson.** *Roy. Meteorolog. Soc., J.* 63. *pp.* 477–482, *Oct.*, 1937.—The present paper forms a discussion of a previous paper [see Abstract 2094 (1936)]. The temperature values at different levels given in the paper referred to and arrived at through the determination of density of ionisation and collision-frequency of free electrons at various levels are compared with those arrived at by other investigators by different methods. Differences in results are seen to exist and these differences are discussed. The author then turns to diurnal temperature variation and deals with the possible explanation of the fall of the F-layer on which this variation is based. Other features discussed are the correlation of conditions in the ionosphere with barometric pressure at the ground, the amount of water vapour in the outer atmosphere and the correlation between pressure and and the amount of ozone in the upper atmosphere. A. E. M. G.

**4897. Temperature Distribution within the Auroral Region of the Atmosphere. L. Vegard.** *Phil. Mag.* 24. *pp.* 588–598, *Oct.*, 1937.—Examination by interferometric methods of the lines λλ6300 and 5577 in auroræ at Oslo over a change in altitude from 100 to 200 km., shows no such variation as would support the theory that the slow diminution in density above 80 km. is due to rise in temperature. [See Abstracts 2094 (1936) and 3489 (1937).] C. A. S.

**4898. Lunar Atmospheric Tide at Five Japanese Stations. S. Chapman.** *Roy. Meteorolog. Soc., J.* 63. *pp.* 457–470, *Oct.*, 1937.—The lunar atmospheric tide at five Japanese stations, Taihoku, Naha, Kumamotu, Tokyo and Sapporo, in latitudes 25°, 26°, 33°, 36°, 43° N., have been found from bi-hourly values of the barometric pressure extending, in the aggregate for the five stations, over 193 years. The harmonic coefficients for the solar diurnal barometric variation at these stations have also been calculated. AUTHOR.

**4899. Ten-Day Forecasting as Developed by Franz Baur. G. T. Walker.** *Roy. Meteorolog. Soc., J.* 63. *pp.* 471–475, *Oct.*, 1937.—The forecasting referred to is the forecasting of the " broad-weather " situation, a general account of which is given in *Met. Zeits.* July, 1936. An explanation of the term is given. The author then proceeds to deal first with the basis of the method and thereafter with actual observations. The control of pressure at 5 km. on changes at ground level is indicated, showing that the motion of these changes undergoes steering. Consideration is next given to the reality of broad-weather conditions, and the importance of these in forecasting for 5 to 10 days. A brief account of the methods used is then set out and a typical example of a forecast given. Charts illustrate the different types of steering. A. E. M. G.

**4900. Energy Realisable in the Atmosphere. C. W. B. Normand.** *Roy. Meteorolog. Soc., J.* 63. *pp.* 494–497, *Oct.*, 1937.—Examples are given of the use of the graphical method in investigating the possible sources of energy in the atmoshpere. It is assumed that changes take place adiabatically and that in the final state entropy increases upwards, that in each column the lapse rate is constant and in stable equilibrium and that the horizontal areas of the columns are equal. Among the cases considered are those where a warm column is below a potentially colder column and where columns of similar depth are alongside one another. In the discussion the effect of humidity is neglected, but the author points out how this may also be allowed for. The reason for Margules' conclusion about the non-effectiveness of latent heat as a source of energy is shown to have arisen from the particular example chosen. A. E. M. G.

***4901. Aitken's Apparatus and Measurement of Condensation Nuclei. G. Aliverti.** *Com. Geod. e Geofis., Boll.* 7. *pp.* 43–51, *Jan.–April*, 1937.—The pump in Aitken's nucleus counter is made to function over a prolonged period by a modification of the piston. Also Schultze has altered the dimensions, making the graduations exact, but changing the expansion ratio from 1·20 to 1·37. With this apparatus observations were taken from July–Dec., 1936, in Turin, near the coast, in the country and on the mountains, and the results correlated and examined. H. M. B.

**4902. Summer at the North Pole. E. L. Hawke.** *Roy. Meteorolog. Soc., J.* 63. *pp.* 491–493, *Oct.*, 1937.—A comparison is made between the results of observations at or near the North Pole obtained during the present summer by the Soviet expedition and those obtained during the drift of the Fram in an average latitude of 83° N. from 1893 to 1896. The results show temperatures higher than those obtained on the Fram. Overcast skies, high relative humidity and frequent rain and drizzle followed later by sleet and snow are some of the outstanding features of the past summer A. E. M. G.

**4903. Light of Night Sky. H. Garrigue.** *Comptes Rendus*, 205. *pp*. 491–493, *Sept*. 13, 1937.—The author continues his work [see Abstract 3565 (1936)] on the diurnal and annual variations of intensity in the lines 5577, 5888, and 6300 Å. Radiation at about 6520 Å. does not vary during twilight and is more intense in winter than in summer. During twilight the 6300 Å. line decreases gradually in intensity as the sun sinks further below the horizon. The interpretation due to Cabannes [see Abstract 5069 (1936)], involving a resonance excited by solar radiation in OI atoms, is shown to be insufficient, since even in the earth's shadow $\lambda 6300$ is intense after sunset and then gradually wanes. Towards dawn the intensity increases again. The mean intensity excluding twilight remains constant throughout the year. The line 5888 Å. exhibits no diurnal variation but declines in brightness during summer. At $\lambda 5577$ the time of maximum intensity depends on the azimuthal position of the spectrograph. The ratio horizon intensity/zenith intensity in winter is 1·8 to 2·5 for $\lambda 6300$; 2 to 3 for $\lambda 5888$; 1·5 to 7 (usually about 2) for $\lambda 5577$. A. Hu.

***4904. Relative Humidity Nomograph. S. M. Troxel.** *Rev. Sci. Instruments*, 8. *p*. 350, *Sept*., 1937.—The nomograph is based on the equation $e = e' + 0{\cdot}000652\mathrm{P}t'(1 + 0{\cdot}00102t') - 0{\cdot}000652\mathrm{P}t(1 + 0{\cdot}00102t')$, where $e$ is the absolute humidity and $e'$ the saturation vapour pressure at $t'$, both expressed in mm. of Hg. As an approximation $(1 + 0{\cdot}00102t')$ is put equal to a constant in the last term and the equation rearranged. From this new form of the equation the nomograph shown in the paper is constructed. With the aid of a ruler the relative humidity can then be obtained directly when wet-and dry-bulb temperatures are known. The effects of variations in the "constant" introduced above and in the barometric pressure are discussed. A. E. M. G.

***4905. Hygrometers with Transparent Leaves. G. Loeser.** *Zeits. f. Instrumentenk*. 57. *pp*. 389–405, *Oct*., 1937.—Various methods are tested for the determination of relative humidity using transparent leaves; the change of length is best in meteorology, and the necessary constants are found. The best reduction curve is obtained by a combination of hair and weatherproof viscous leaf for the measuring element, using a dilatation hygrometer or hygrograph. Colour changes in leaves impregnated with salts are most intense when using equal parts of cobalt chloride and copper chloride; this method has an application in aerological ascents. It is shown that an absolute vapour-pressure measurement using gelatin leaves gives an accuracy sufficient for meteorological station requirements. R. S. R.

*See also* Abstracts 5024, 5123.

## SEISMOLOGY.

**4906. Coupling Effect Due to Damping. G. Schmerwitz.** *Ann. d. Physik*, 30. 3. *pp*. 209–223, *Oct*., 1937.—Arising out of geophysics it is noted that a coupling due to damping is possible since such an effect is produced by a seismograph coupled to a galvanometer. The theory of the general case is worked out, and is applied to certain special cases, *e.g.*, when the frequencies and the damping factors of the separate systems are respectively the same. Experimental examples are given to show how the resultant frequencies vary with the original frequencies, the damping and the tightness of coupling. It is found that, in contrast to acceleration coupling, the resultant frequencies do not alter, but that the degree of damping of the system becomes considerably less as the coupling is increased. It is suggested that the effect of this type of coupling is important in electrical circuits in which two such damped instruments are used for measuring currents and voltages, and also in many technical cases.

H. M. B.

## TERRESTRIAL ELECTRICITY AND MAGNETISM.

**4907. Centre of Earth's Magnetism and Directions of the Secondary Axes. R. Perassi.** *Com. Geod. e Geofis., Boll.* 7. *pp.* 32–42, *Jan.–April,* 1937.—Calculations are made for establishing the position of the centre of magnetism and the directions of the secondary axes as they are defined by Maxwell for the case of terrestrial magnetism, making use of the numerical data of Neumayer. There are then determined the geographical coordinates on the earth's surface of the point determined by the joining of the terrestrial centre with the centre of magnetism, and of those determined from the secondary axes proceeding from the centre of the earth. The centre of terrestrial magnetism is situated at about 700 km. from the centre of the earth in the direction of the point of latitude 0° and longitude 170° E.

J. J. S.

*See also* Abstracts 4895, 4896.

## RADIOACTIVITY.

**4908. Intervals between Radioactive Emissions. Part I. E. J. Gumbel.** *J. de Physique et le Radium*, 8. *pp.* 321–329, *Aug.*, 1937.—The author attempts to apply the theories concerning the extreme values of the statistical distributions as regards radioactive emissions. Since radioactive emissions can be regarded as following each other in time, one can then speak of intervals between the emissions. Two methods of considering these intervals lead in one case to an exponential distribution and in the other case to the law of rare events. These two distributions which appear to be purely statistical have also a physical significance. The author deals with the initial distribution, calculates the mean interval between consecutive emissions and establishes the distribution of the mth. interval and its characteristics. For the extreme intervals, this distribution tends, even for a moderate number of observations, towards the final distribution. Finally, the necessary criteria are established for a comparison between theory and experiment. G. O. B.

**4909. Range of α-Particles of U I and U II. G. J. Sizoo and S. A. Wytzes.** *Physica*, 4. *pp.* 791–809, *Oct.*, 1937. *In English.*—The relation between the range of α-particles measured by the " sphere method " and the extrapolated ionisation range is discussed. The ranges of U I and U II were measured by this method and found to be 27·47 and 33·0 mm. in terms of air at 15° and 760 mm. These values agree, within the limits of accuracy, with the values found by Laurence and by Kurie. The conclusion is drawn that the Geiger-Nuttal-rule cannot be used to calculate the periods of transformation from the ranges with sufficient accuracy.

AUTHORS.

**4910. Shape of the Continuous β-Spectrum of Thorium C.C′. H. O. W. Richardson and Alice Leigh-Smith.** *Roy. Soc., Proc.* 162*A*. *pp.* 391–403, *Oct.* 1, 1937.—A method is described by which a radioactive vapour of Th (B + C) was introduced into a cloud chamber. About 200 Th C.C′ disintegrations occurring in the gas were photographed and the energies of the nuclear electrons were estimated. A large proportion of low energy electrons was found extending down to the lowest detectable energy of about 15 kV. It is concluded that the energy distribution curve does not pass through the origin but passes well above it, showing no marked fall near zero energy. The curve agrees within experimental error down to zero energy with the shape predicted by the (0, 1) interaction formula of Konopinski and Uhlenbeck [see Abstract 3410 (1935)]. The maximum electron energy obtained by fitting the data to the (0, 1) formula is 2700 ± 100 kV. The possible presence of higher order derivatives in the interaction energy is discussed. Numerous secondary electrons were observed associated with the α-rays of Th C.C″. AUTHORS.

**4911. Ionisation Measurement of γ-Radiation. G. W. C. Kaye and W. Binks.** *Roy. Soc., Proc.* 161*A*. *pp.* 564–592, *Aug.* 20, 1937.—Previous work showing difficulties in realising unambiguously the " röntgen " for γ-rays, the authors repeated the work using both large " free air " chambers and the normal types of thimble chambers. The results show that, subject to minor corrections, quantities of γ-radiation may be measured either by air-wall chambers or by free-air chambers of sufficient size to take account of the long ranges of electrons from the air. In practice a chamber of the free-air type having effective dimensions 12 × 10 ft., gave satisfactory results. The amount of $\gamma$-radiation per hour at 1 cm. from 1 mg. of Ra (point source) filtered by 0·5 mm. of Pt was found to be 8·0 r., whether measured by free-air or air-walled chambers. G. E. B.

**4912. Number of Quanta of $\gamma$-Rays Emitted from a Nucleus by Neutron Capture. H. Aoki.** *Phys. Math. Soc., Japan, Proc.* 19. *pp.* 799–805, *Sept.*, 1937. *In English.*—Using the method of coincidence of two Geiger-Müller counters, the mean number of $\gamma$-ray quanta emitted from a nucleus when it captures a neutron is estimated. Several quanta of $\gamma$-rays are thus frequently emitted. AUTHOR.

**4913. Hard $\gamma$-Rays from Ra $(C + C' + C'' + D)$. S. Nishida.** *Phys. Math. Soc. Japan, Proc.* 19. *pp.* 809–818, *Sept.*, 1937. *In English.*—As early as 1913 Danysz, and later Rutherford and others, observed that RaC emits very hard $\gamma$-rays which are incapable of being analysed, only measurements of energies of their internal conversion electrons being possible. Rutherford and others remarked that these electrons might be disintegration electrons, according to the results of Yovanovitch and d'Espine who found that they have wide bands. The result of the present observations of electron tracks of the hard $\gamma$-rays in a Wilson chamber shows the hardness to be about 3·1, 4 and 4·9 $\times 10^6$ eV. It seems, therefore, that such an abnormal $\beta$-decay phenomenon as Rutherford and others observed, is not to be expected. The conclusion is reached, after carefully considering the energy relations of RaC branch-products, that these hard $\gamma$-rays can be ascribed to the emissions from $RaC'' \rightarrow RaD$, and the energy-diagram between RaC and RaD is constructed. AUTHOR.

**4914. $\gamma$-Ray Spectrum of $B^{10}$. P. G. Kruger and G. K. Green.** *Phys. Rev.* 52. *pp.* 773–776, *Oct.* 15, 1937.—The $\gamma$-rays from $B^{10}$, produced by bombarding Be with 1 eMV deuterons, have been investigated by an examination of the momentum distribution of Compton electrons ejected from a thin mica foil in an expansion chamber. This spectrum consists of six $\gamma$-rays of energies 0·51, 1·07, 1·44, 1·96, 2·81 and 3·21 eMV. These $\gamma$-rays result from all possible transitions between three excited levels and the ground state of $B^{10}$. The energy levels determined are in agreement with those obtained from a study of the neutron spectrum emitted by the same reaction. AUTHORS.

***4915. Simplified Wilson Chamber. S. Nishida.** *Phys. Math. Soc., Japan, Proc.* 19. *pp.* 806–808, *Sept.*, 1937. *In English.*—A description is given of a simplified Wilson chamber which can be easily constructed with small expense, and is sufficient to take photographs of any tracks of high-speed particles. AUTHOR.

***4916. Electron Lens in Cloud Chamber Photography. W. T. Davies and C. O'Ceallaigh.** *Cambridge Phil. Soc., Proc.* 33. *pp.* 540–548, *Oct.*, 1937.—A single magnetic lens spectrograph of Klemperer the type is used to focus electrons of energies between 1 and 2·5 eMV. The method permits shielding of the expansion chamber from the $\gamma$-rays emitted by the source. With a magnetic lens current of 7 A and an object distance of 50 cm., radon sources of about 10 millicuries are required to give adequate numbers of tracks in the expansion chamber. F. C. C.

***4917. Scale-of-Two High-Speed Counter Using Hard Vacuum Triodes. W. B. Lewis.** *Cambridge Phil. Soc., Proc.* **33.** *pp.* 549–558, *Oct.*, 1937.—A high-speed recording counter circuit is described which has proved very reliable. The basic circuit element employs two triodes in a symmetrical circuit which has two stable conditions. The circuit is triggered alternately from one stable state to the other by the applied impulses acting through a circuit comprising two " Westector " cuprous oxide rectifiers and an inductance. It is easily possible to make a counter operate accurately at a speed of 20,000 random impulses a minute, provided that the associated recording meter operates in less than 1/100 sec. A " watch dog " thyratron recording circuit is also described. This is useful where the slow speed of the mechanical recording meter would introduce loss. AUTHOR.

***4918. Scale-of-Eight Counting Unit. J. Giarratana.** *Rev. Sci. Instruments*, 8. *pp.* 390–393, *Oct.*, 1937.—The factors involved in the design of a counting circuit using gas triodes are discussed. A complete circuit is given for a scale-of-eight unit together with a graph showing the performance of such a unit when used to count α-particle pulses from a linear amplifier. AUTHOR.

***4919. Geiger-Müller Counter for Radio-Chemical Investigations. F. T. Hamblin, C. H. Johnson, and H. Todd.** *Phil. Mag.* **24.** *pp.* 553–582, *Oct.*, 1937.—A detailed description of such a counter is given. A maximum counting speed of 1200 ± 50 per min. is consistently obtained. With the aid of necessary corrections dealt with in a separate portion of the paper by **H. Todd** an experimental verification of which is contained in an Appendix by **F. T. Hamblin**, very accurate results are obtained, *e.g.*, that for radio-iodine agreed closely with that of Amaldi, etc. [see Abstract 1899 (1935)]. C. A. S.

***4920. Neon-Tube Radium Detector. P. R. Pallister.** *Brit. J. of Radiology*, 10. *pp.* 759–763, *Oct.*, 1937.—A compact form of neon-tube radium detector is described which dispenses with h.v. batteries and is independent of the mains supply. The source of voltage is a 1·5-volt dry cell operating a transformer in conjunction with an interrupter. AUTHOR.

*See also* Abstracts 4752, 4762, 4763, 4767, 5118.

# RADIATION.

## ABSORPTION AND TRANSMISSION.

**4921. Absorption by Thin Films of Copper Sulphide. J. Cayrel.** *Comptes Rendus,* 205. *pp.* 488–490, *Sept.* 13, 1937.—The absorption of the Hg 4358 Å line by thin films of CuS on glass is measured photoelectrically. The absorption coefficient can be deduced when the thickness of the film, determined by chemical estimation of the Cu in a known area, is known. The thicknesses of films can also be compared directly by this method. C. B. A.

**4922. Absorbing and Reflecting Powers of Electrolytes in the Far Infra-Red. C. H. Cartwright.** *J. Chem. Phys.* 5. *pp.* 776–786, *Oct.,* 1937.—The absorbing and reflecting powers and the dispersion of different concentrations of HCl, LiCl, NaCl, KCl, KBr, LiI, KI, $ZnI_2$, $MgSO_4$, KOH and $H_2SO_4$, were measured in the spectral region of 50$\mu$ to 150$\mu$. The results are discussed in terms of (1) Maxwell's equations in which the inertia of the ions is included, (2) the influence of ions on the absorbing power of water molecules, (3) the electrical conductivity for h.f. electromagnetic fields, (4) the radius of ions, (5) the hydration of ions and (6) the validity of Stokes' law for the microscopic processs involved. AUTHOR.

***4923. Jena Dispersion-Filter as Monochromator for Photochemical Purposes. G. Holst.** *Zeits. f. wiss. Phot.* 36. *pp.* 145–155, *July,* 1937.—The Jena dispersion-filter (Schott u. Gen.) is of the Christiansen type, employing borosilicate glass immersed in benzoic esters. Its transmission-maximum occurs at a wave-length $\lambda_0$ given by $\lambda_0 = 1/\sqrt{\alpha + \beta T}$, where T is temperature and $\alpha$ and $\beta$ are constants. By varying T (12°–60° C.) $\lambda$ can be adjusted over the range 700–400 m$\mu$. The author gives a theoretical and experimental analysis of the width of the transmission band and of the total flux transmitted, both as function of temperature, using as light-source an enclosed tungsten arc (3000° K.). For the energy measurements a barrier-layer cell (Se) was employed, the calibration of which is described. L. V. C.

***4924. Fluorescence in Colour Filters. H. Bäckström and R. Johansson.** *Zeits. f. wiss. Phot.* 36. *pp.* 194–206, *Aug.–Sept.,* 1937.—The fluorescence exhibited by an aesculin filter is such that if a filter of this kind is used over a camera lens there is a noticeable fogging and loss of detail. A number of commercial filters have been examined by the authors to determine whether their fluorescence produces noticeable effects of a similar kind. The results obtained show that both glass and gelatine filters of certain types are bad from this point of view, while others are almost free from fluorescence. The worst are the very bright yellow filters: on the other hand u.v. absorbing filters show very little fluorescence. With composite filters it is sometimes important to use the filter so that the light passes through it in one direction rather than in the other. Some filters show a very patchy fluorescence over the surface. The results given in this paper are comparative. Further work on the subject is to follow. J. W. T. W.

## COLORIMETRY.

**4925. Colorimetry in Relation to Photometry. J. Guild.** *Illum. Eng. Soc.* (*London*), *Trans.* 2. *pp.* 128–134, *Sept.*, 1937.—A general summary of the trichromatic system of colour measurement and of the units and standards used on that system. It is pointed out that a trichromatic colorimeter is, in effect, a universal heterochromatic photometer in which colour differences are avoided. The influence of peculiarities in the colour vision of the observer is described and the characteristics of the I.C.I. standard observer are referred to, as well as the necessity for standardising the conditions of observation. J. W. T. W.

**4926. Theory of Colour Printing. H. E. J. Neugebauer.** *Zeits. f. wiss. Phot.* 36. *pp.* 169–182, *Aug.–Sept.*, 1937.—Continues previous work [see Abstract 2540 (1937)] extending it to the case of four printings, one black and the others yellow, blue-green and purple respectively. In the study of the subtractive colour mixtures met with in colour reproduction it is possible to use formulæ analogous to those employed for additive colour mixtures. The formulæ can be generalised to deal with cases of mixtures of more than three colours. J. W. T. W.

## ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

**4927. Magnetic Rotation Spectra of Diatomic Molecules. T. Carroll.** *Phys. Rev.* 52. *pp.* 822–835, *Oct.* 15, 1937.—The general theory of the Faraday effect associated with a single molecular absorption line is presented. The effect of the perturbation of the transition probabilities by the field in producing asymmetrical rotation is discussed, and calculated for alkali band systems and for $I_2$. The observations on asymmetrical rotation in $I_2$ agree with the predictions. The longitudinal Zeeman patterns and the changes in these patterns produced by the field are related to the vector model by use of the criterion that transitions which involve little change in the direction of J, the rotational axis, are the most probable ones. It is shown that all known facts about the $^1\Sigma \leftarrow {}^1\Sigma$ magnetic rotation systems of $Na_2$ and $K_2$ can be explained by assuming the upper state to be perturbed by an unknown $^3\Pi_0$ state. The constants have been calculated for this predicted perturbing state in $Na_2$. AUTHOR.

## FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

**4928. Fluorescence Efficiencies of Solutions of Hydrocarbons. E. J. Bowen and J. W. Sawtell.** *Faraday Soc., Trans.* 33. *pp.* 1425–1429, *Oct.*, 1937.—By means of a photo-cell combined with an "integrating screen," which provides a uniform wave-length sensitivity over the necessary range, the u.v. fluorescent efficiencies of a number of simple hydrocarbons in hexane and ethyl alcohol solution have been measured. AUTHORS.

**4929. Selective Extinction of Continuous Fluorescence. N. Prileshajewa.** *Acta Physicochimica*, 7. 2. *pp.* 149–162, 1937. *In German.*—In order to detect any resonance effect through the transfer of electron energy into vibrational energy, the quenching of the fluorescence of toluol, ethyl benzol, phenol and aniline by $N_2$, $O_2$, CO, $CO_2$, $H_2O$ and $NH_3$ is investigated. In the case of the diatomic molecules $N_2$ and CO maxima of the quenching waves have been found at the frequencies corresponding to vibration energy levels of these molecules. For $H_2$ the maximum which is found to occur at about 2800 Å corresponds to the dissociation energy of the $H_2$ into atoms. For $CO_2$ and $H_2O$ the maxima are at 4·3 and 4·1 V respectively, probably representing the activation energy for a monomolecular decomposition. No selective quenching was found for $O_2$ or $NH_3$. This selective effect is regarded as a kind of Raman effect by collisions of the second kind. The possibility and usefulness of such a conception is discussed. J. E.

**4930. Sensitised Fluorescence of Aniline and Benzene Vapour. N. Prileshajewa and A. Klimowa.** *Acta Physicochimica,* 7. 2. *pp.* 163–170, 1937. *In German.*—The process of sensitised fluorescence is regarded as associated with the intersection of the potential curves of the two systems $A + B^* \rightarrow A^* + B$. From this view-point the reverse process is to be expected if the required energy balance is available from any existing energy source. This reverse process corresponds to an anti-Stokes fluorescence. These two processes have been followed in the cases of aniline and benzene mixtures in line with the formerly discovered anti-Stokes emission of aniline and indigo vapour. J. E.

**4931. Quenching of Fluorescence of Excited Mercury Halide-Radicals. S. Tibilov.** *Acta Physicochimica,* 7. 2. *pp.* 171–192, 1937. *In German.*—The quenching of the fluorescence is studied of excited mercury halide radicals (obtained by photodissociation of mercury halide molecules) by the addition of $O_2$, $CO_2$, CO, $H_2$, A, $NH_3$ and $N_2$. $HgI^*$ shows quenching of its u.v. band system, the gases working in the order $NH_3 > O_2 > CO_2 > N_2 > CO > A > H_2$. No relation is found between coincidence of energy levels of excited HgI and vibration levels of quenching gas and quenching effect. For the visible bands $HgI^*$ is more quenched than $HgBr^*$ and the latter more than $HgCl^*$. The especially strong quenching effect of $NH_3$ is attributed to a chemical reaction between the $NH_3$ and the excited mercury halide. $N_2$, A and CO enhance the fluorescence of the visible band. J. E.

**4932. Cement Phosphors. M. Travníček.** *Ann. d. Physik,* 30. 3. *pp.* 224–244, *Oct.,* 1937.—The preparation is described of a new class of very bright organic phosphors of long duration. In one case the duration is 2 hrs. With some of the preparations there appear to be two different kinds of emission spectra; a continuous one under excitation with daylight and a set of discrete bands under u.v. excitation. The temperature properties have been followed. Under long irradiation the substances show a colour change which is slowly and spontaneously reversed in the dark. The influence of alkali halides on the duration of the phosphorescence is also studied. J. E.

**4933. ZnS-CdS Phosphors. K. Kamm.** *Ann. d. Physik,* 30. 4. *pp.* 333–353, *Oct.,* 1937.—A new method of preparing pure ZnS is described. This method makes use of the fact that Zn precedes in the Volta series those metals which as impurities spoil the sulphide as a luminescent ground material. The following points emerge from the study of the preparation and characteristics of the phosphors. (1) ZnS can be replaced to any extent by the isomorphous CdS. (2) Increasing the Cd content shifts the emission towards the red. (3) Pure CdS/Cu and CdS/Ag phosphors show under kathode rays a beautiful deep red luminescence with a maximum in the infra-red. (4) The higher the Cd content in the mixed phosphors the greater is the amount of activator required to produce the same intensity. (5) Afterglow decreases with increasing Cd content and with increasing activator content. (6) The intensity distribution can be altered by the activator content. By variation of the heating time, flux percentage, temperature and activator content, almost any colour can be obtained. J. E.

**4934. Triboluminescence of Crystals. Frances G. Wick.** *J.O.S.A.* 27. *pp.* 275–285, *Aug.*, 1937.—The emission of triboluminescence is divided into three categories: (*a*) That which closely resembles phosphorescence and low-temperature luminescence, is attributed to unstable excited centres which may be activated by exposure to Ra, X-ray or kathode rays. (*b*) That characteristic of the material itself, independent of excitation other than mechanical breaking or crushing, is attributed to stable, heat-resistant centres. (*c*) That due to electric discharge. A large number of substances were examined, fluorites containing small traces of rare earths or Mn, $CaSO_4$ containing Sm or Mn, calcite, apatite, chalcedony, perlsinter, rock-salt, felspar, quartz, sphalerite, willemite, synthetic materials containing Mn, glass and sugar. The materials were crushed in a vice, ground in a mortar, scratched with a file, or ground on a stone grindstone. Some were ground under liquids. The effect of preheating in a blast was investigated. The results for different materials and methods of excitation are discussed with regard to the classification above. Materials which show marked triboluminescence contain small traces of activators. A. C. M.

**4935. Recombination of Ions in the Afterglow of a Cæsium Discharge. F. L. Mohler.** *Bureau of Standards, J. of Research*, 19. *pp.* 447–456, *Oct.*, 1937.—A discharge through a 500-cm³. bulb is short-circuited by a motor-driven commutator and the radiation and electrical characteristics of the afterglow are studied. Radiation at a definite time-interval after the cut-off was observed by means of a sectored disc on the commutator shaft, while electrical measurements were made by a closing a probe circuit momentarily by means of a second commutator. The afterglow fades at a rate which decreases with increasing pressure up to 46μ and remains nearly constant (the half-value time for a 6-A discharge is $1 \cdot 5 \times 10^{-3}$ sec.) in the pressure range 46 to 110μ. The spectral-intensity distribution of the continuous recombination spectrum indicates a much lower electron temperature than in the discharge, decreasing with time from 1360° K. at $0 \cdot 9 \times 10^{-3}$ sec. to 1200° K. at $1 \cdot 7 \times 10^{-3}$ sec. The number of ions at any time during the afterglow is measured by the positive-ion current to a negative probe, and the flow of ions to the wall is measured by the current to a collector against the bulb wall. The difference between the change in number of ions in the bulb and the flow of ions to the wall gives the number recombining in the space. From this is derived a recombination coefficient of $3 \cdot 4 \times 10^{-10}$ in the pressure range 10 to 30μ. AUTHOR.

*See also* Abstract 4924.

## INTERFERENCE, DIFFRACTION AND SCATTERING.

**4936. Identification of Opaque Solids by Selective Iridescent Filming. A. M. Gaudin.** *J. Phys. Chem.* 41. *pp.* 811–859, *June*, 1937. —A full examination is made of the various interference effects obtained from the surfaces of minerals, and the underlying theory is discussed at length. Details are also given of the methods employed to coat plane surfaces of opaque substances with virtually transparent thin films of such physical properties that interference effects will result. A. H.

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**4937. Depolarisation of Light Scattering. R. Gans.** *Phys. Zeits.* 38. *pp.* 625–626, *Aug.* 15, 1937.—If Δ is the depolarisation factor, and suffixes *u, h, v,* indicate that the incident light is unpolarised, horizontally and vertically, respectively, when the plane of scattering is horizontal, then $1/\Delta_u = (1/\Delta_v + 1/\Delta_h)/2$ according to the author. This is not in agreement with the formula derived by Krishnan, and Gans claims that his formula fits Krishnan's experimental data better. [See Abstract 3530 (1937).] A. C. M.

*See also* Abstracts **4941, 5048.**

## PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

**4938. Direct Photochemical Decomposition of Nitrous Oxide. W. A. Noyes, Jr.** *J. Chem. Phys.* 5. *pp.* 807–812, *Oct.,* 1937.—The number of molecules of gas uncondensed by liquid air formed per quantum absorbed by $N_2O$ has been determined both in the presence and absence of Hg. At least part of the primary dissociation must be into $N_2$ molecules and O atoms. A mechanism consistent with the facts involves the subsequent reactions $O + N_2O = 2NO$ and $O + O = O_2$. However, it is impossible to state definitely that none of the primary dissociation is into NO molecules and N atoms. The weakness of the absorption suggests that the absorption is " forbidden " and it is possible that the $N_2$ molecules and O atoms are produced in their normal electronic states (with perhaps some vibrational energy in the $N_2$ molecule). AUTHOR.

**4939. Theory of Departures from Reciprocity Law. J. E. de Langhe.** *Zeits. f. wiss. Phot.* 36. *pp.* 162–167, *July,* 1937. The author's statistical theory of the photographic characteristic curve [see Abstract 625 (1937)] is extended to study changes in the direct Schwarzschild effect when the number of Ag atoms assumed to be necessary to form a development centre is increased. The same analysis leads to the conclusion that unripened emulsions should show a more pronounced Schwarzschild effect than ripened emulsions, a conclusion supported by experiment. L. V. C.

**4940. Photoelectric Photometry in the Printing of Amateur Negatives. C. M. Tuttle.** *Kodak Research Lab., Comm. No.* 614. *Frank. Inst., J.* 224. *pp.* 315–337, *Sept.,* 1937. In preparing paper prints from amateur negatives the photofinisher has control over the printing exposure and the choice of paper grade. A statistical examination of prints from negatives from 100 amateurs, covering all types of subject and negative exposure but given standardised development, showed that (i) exposures based upon physical measurements of total negative density [$\log_{10}$ (reciprocal of total negative transmission)] gave results better than the subjective judgments of 4 out of 6 professional photofinishers, the result being judged by the statistical acceptability of the prints to representative amateurs; (ii) exposures based upon maximum or minimum negative density gave less satisfactory prints; (iii) for the negatives used, a single grade of paper (somewhat softer than the medium bromide paper employed) would suffice; (iv) in the absence of controlled negative development more than one paper grade would be necessary, but only a doubtful advantage would be gained by using a physical rather than the subjective method of determining the choice of paper for a given negative. L. V. C.

**4941. Light Scatter in Photographic Film. H. Siedentopf.** *Zeits. f. wiss. Phot.* 36. *pp.* 183–187, *Aug.-Sept.,* 1937.—A theoretical treatment of the problem of light scatter in an exposed photographic film, with particular reference to the viewing of a negative as a positive by reflected light (backward scatter). The case of transmitted light (forward scatter) is also considered. J. W. T. W.

**4942. Tone Reproduction in Photography. R. G. Hopkinson.** *Phot. J.* 77. *pp.* 542–559; *Disc.*, 559–564, *Sept.*, 1937.—The author states the principles underlying true tone reproduction. These are (i) unity contrast (*i.e.*, the ratios of brightnesses in the original must be reproduced unchanged) and (ii) correlation of the subjective blacks. This latter expression means that the brightnesses in the reproduction must bear the same ratio to true subjective black at the level of brightness used for viewing as the brightnesses in the original bear to the true black at the level of brightness obtaining in the original scene. These principles have been tried out in practice and found, generally, to give satisfactory results. The limitations of the photographic printing process are examined, and their effect on the application of the principles mentioned above is considered in the later part of the paper. In the *Discussion*, **F. F. Renwick** said that the principle of unity contrast might break down under certain conditions; **W. D. Wright** pointed out that no single procedure could give correct tone reproduction at all brightness levels; **F. H. G. Pitt** said that the adaptation level for the eye was not the average brightness of the print or transparency but some higher level. J. W. T. W.

**4943. Theory of Desensitisation. K. Weber and B. Schönbaum.** *Zeits. f. wiss. Phot.* 36. *pp.* 188–194, *Aug.–Sept.*, 1937.—In continuation of previous work [see Abstract 2691 (1936)] the authors have studied the desensitising effect of different materials on sensitive films made without collodion and the results obtained are compared with those found in the case of gelatin emulsions. J. W. T. W.

**4944. Production of Latent Image by Hydrogen Peroxide. M. W. Jones and J. M. Blair.** *J. Chem. Phys.* 5. *pp.* 835–836, *Oct.*, 1937.—Much of the density previously reported as produced by short immersions of photographic plates in aqueous solutions of $H_2O_2$ was found to have been produced during the washing interval between exposure and development. Data are presented concerning the production of the latent image by various concentrations of $H_2O_2$. Analysis of these data suggests that, initially, the net reaction is of the second order. An optimum concentration for the production of maximum density was indicated. AUTHORS.

**4945. Permanence of Motion-Picture Films. J. R. Hill and C. G. Weber.** *Bureau of Standards, Misc. Publ. M*158. [5 *pp.*], 1937.—In previous publications [see Abstract 630 (1937)], the results have been reported of studies on the stability of motion-picture film and its care in libraries. This paper gives detailed test methods for determining folding endurance, pH, copper number, and relative viscosity. For record purposes film having a base of cellulose acetate free from cellulose nitrate is recommended. The cellulose acetate film should have the following resistance to an ageing test consisting in heating 72 hrs. at 100° C. Retention of folding endurance, not less than 75%; decrease in relative viscosity, not over 3·0%; increase in copper number, not more than 0·2; a change in pH of not over 0·5. Developed film should be free from sodium thiosulphate. AUTHORS.

**✱4946. Testing Focal Plane Shutters. J. A. M. van Liempt and J. A. de Vriend.** *Physica*, 4. *pp.* 811–827, *Oct.*, 1937. *In English.*—

A method is worked out for measuring with the aid of a kathode-ray tube the course of either of the blinds of a focal plane shutter as a function of the time. The exposure time and the efficiency can be deduced from the results found. [See also Abstract 3845 (1935).] **Authors.**

*See also* Abstracts 4787, 4879, 4923, 4924, 4963, 4964, 4965.

## PHOTOMETRY.

***4947. Photoelectric Counter for Ultra-Violet Light. A. Drigo.** *Ricerca Scientifica,* 8. *pp.* 468–479, *June,* 1937.—The construction of a photoelectric counter of high sensitivity and stability is described. Relative and absolute sensitivities are found for different kathodes. Characteristic curves are obtained under various conditions and diverse results obtained by other workers are discussed. F. C. C.

***4948. Precision Photometry with Rectifier Photo-Cells. F. Buchmüller and H. König.** *Assoc. Suisse Élect., Bull.* 28. *pp.* 89–99, *March* 5, *and pp.* 385–393, *Aug.* 20, 1937. *In German.*—Describes in detail the various types of photometric measurements made at the Berne Bureau of Weights and Measures, using Se rectifier cells. The electrical apparatus used with the cells is described, together with such auxiliary apparatus as sector discs, reducing screens, etc. The measurements include horizontal c.p. (directional), c.p. distribution (for polar curves), mean spherical c.p., spectral distribution (including slit-width correction), colour temperature, etc. The various precautions necessary in making each type of measurement are set out in detail. J. W. T. W.

*See also* Abstracts 4925, 4940.

## POLARISATION.

**4949. Optical Rotation and Rotatory Dispersion. F. M. Jaeger, J. ter Berg, and P. Terpstra.** *K. Akad. Amsterdam, Proc.* 40. 7. *pp.* 574–579, 1937.—In a crystal optical rotatory power may be caused either by the asymmetrical arrangement of symmetrical molecules—as in sodium chlorate—or by the asymmetrical arrangement of asymmetrical molecules. In this latter case a " molecular " rotation and a " structural " one are superimposed. Measurements are described of the specific rotation of the crystals ($\rho$) and of the solution ($\alpha$) of the Co and Cr salts of optically-active trans-cyclohexane-1-2-diamine. For both salts $\rho$ has a dextro-gyratory sign for all wave-lengths of the visible spectrum, whilst for the solutions $\alpha$ has also a lævo-gyratory sign for some regions in the spectrum. Further, the wave-length for maximum rotation is the same in the salt as in its solution. Longchambon's rule that the ratio $\alpha/\rho$ is constant for all wave-lengths is found not to hold. G. G.

**4950. One-Electron Rotatory Power. E. U. Condon, W. Altar and H. Eyring.** *J. Chem. Phys.* 5. *pp.* 753–775, *Oct.,* 1937.—It is shown that a single electron moving in a field of suitable dissymmetry can give rise to optical rotatory power, and a detailed theory is worked out. It is applied successfully to the analysis of the rotatory powers of methyl phenyl carbinol nitrite and of secondary butyl alcohol. The general quantum mechanical theory of circular dichroism is developed. Kuhn's " anisotropy factor" is defined quantum-mechanically, and an alternative measure of the contribution of an absorption band to rotatory power ("rotatory strength") is introduced. The catalytic dehydrogenation of butyl alcohol on active quartz is discussed and kinetic arguments are advanced to show how the relative configuration of quartz and butyl alcohol may be inferred from it. The influence of dipole moment and solvent on rotatory power are briefly discussed. C. B. A.

*See also* Abstracts 4835, 4937.

## RADIATION, EMISSION.

**4951. Cosmic Rays. J. Clay.** *K. Akad. Amsterdam, Proc.* 40. 7. *pp.* 564–574, 1937. *In Dutch.*—The influence of the earth's magnetic field leaves no doubt as to the corpuscular nature of cosmic rays. This makes it important to determine the energy of the particles. The methods available are: by the application of Störmer's theory; by estimating the loss in energy of particles penetrating matter; from the curvature of the track of particles in a Wilson cloud-chamber; and, finally, from a study of strong bursts of ionisation, first discovered by Hoffmann, which occur in ionisation chambers. All these methods give values of the order of milliards of volts. Cosmic rays consist of two types—the less penetrating being electrons and the more penetrating probably protons—and their absorption in matter is proportional to the density. G. G.

**4952. Disintegration of Nuclei by Cosmic Radiation. S. Nishida.** *Phys. Math. Soc., Japan, Proc.* 19. *pp.* 818–820, *Sept.*, 1937. *In English.*—In the course of experimental work using a Wilson chamber, dense tracks showing the explosions of atomic nuclei by cosmic radiations were observed. Features of the disintegration are discussed. AUTHOR.

**4953. Absorption Curve of Hard Component of Cosmic Rays. A. Ehmert.** *Zeits. f. Physik,* 106. 11–12. *pp.* 751–773, 1937.—Measurements of cosmic-ray intensity were made down to depths of 243 m. water-equivalent in Lake Constance by a coincidence-counting method. For depths below 45 m. the absorption curve can be represented by the form $N = N_1/h^{\epsilon}$. The absorption curve in air up to 55 m. water-equivalent was measured by inclining the counter assembly at various angles to the vertical, and for thicknesses greater than 11 m. the same form was found for the curve. Comparison with the curve for water reveals a transition effect, equilibrium being attained at a depth of 35 m. below the surface. Comparison with ionisation-chamber measurements allows a determination of the residual ionisation in the chambers. The specific ionisation of the radiation was found to be constant at 94 J/cm. at all depths. A 5-cm. Pb filter between the counters absorbs 15–20% of the particles at all depths. The variation of the shower-frequency between 10 and 240 m. followed the same type of law as above, but with a smaller value for $\epsilon$. D. H. F.

**4954. Cosmic-Ray Measurements with Small Ionisation Chamber. R. T. Young, Jr. and J. C. Street.** *Phys. Rev.* 52. *pp.* 552–564, *Sept.* 15, 1937.—Ionisation data have been obtained with a small chamber (230 c.c.) at three corresponding altitudes (76, 51 and 45 cm. Hg) at magnetic latitudes 50° N. and 1° S. approximately, for shielding thicknesses up to 19·4 cm. Pb. The ionisation ratios at the two latitudes are independent of the shield thickness for each altitude studied. An analysis of the Pb absorption curves has been made in terms of a penetrating ionising radiation and a softer secondary radiation. The analysis shows that the ionisation due to secondaries associated with the soft component is to be identified with the shower radiation. The contribution of secondaries is important, even under thick shields. Measurements of the bursts produced in the same chamber have been made at some of these stations, and the ratios for different altitudes for burst groups containing 10–19 rays, 20–29 and 30 and greater determined. The maxima of the burst production absorption curves shift to greater Pb thicknesses with increasing burst size. D. H. F.

**4955. Report on the Work of the Bartol Research Foundation, 1936-1937. W. F. G. Swann.** *Frank. Inst., J.* 224. *pp.* 415–473, *Oct.*, 1937.

**4956. Shot Effect for Showers. J. M. Whittaker.** *Cambridge Phil. Soc., Proc.* 33. *pp.* 451–458, *Oct.*, 1937.—A mathematical treatment of the production of showers of particles by cosmic rays, regarded as events happening in groups, by means of the theory of probability. N. M. B.

*See also* Abstract 5089.

## RADIATION, GENERAL THEORY.

**4957. Empirical Accuracy of Mass-Energy Relation. W. Braunbek.** *Zeits. f. Physik*, 107. 1–2. *pp.* 1–11, 1937.—From 31 different suitably selected nuclear processes the energy accounts of which are known the ratio of energy to its equivalent mass is calculated with the aid of the most recently measured mass values of Aston and Bainbridge. A mean value of 1 mass unit ($O^{16} = 16$) $= 0 \cdot 922 \times 10^9$ eV is deduced with a limiting error of the order of 1%. Using this mean value the equation $E = M/c^2$ is satisfied by $c = 2 \cdot 985 \times 10^{10}$ cm./sec. which agrees with the correct value of the velocity of light within the given limits of error. The mass-energy equation may thus be regarded as empirically established to within 1% error. J. E. K.

**4958. Interaction between Nuclei and Electromagnetic Radiation. A. J. F. Siegert.** *Phys. Rev.* 52. *pp.* 787–789, *Oct.* 15, 1937.—The exchange character of nuclear forces makes it impossible to formulate in a consistent way the coupling between the electromagnetic field and a nucleus described by a model which involves only heavy particles. This difficulty does not occur in a theory which introduces light particles as carriers of the charge in the exchange processes. The actual contribution of these light particles to the transition probabilities is proved to be negligible in the limit of wave-lengths of the radiation large compared with nuclear dimensions and non-relativistic motion of the heavy particles. In this limit one is justified in taking as coupling term $-$ (ED), where D is the dipole moment calculated from the heavy particle model, and E is the electric field. A marked influence of the exchange processes on the radiation properties of the nucleus exists even in the limit considered. AUTHOR.

## REFLECTION, REFRACTION AND DISPERSION.

**4959. Metallic Reflection and Surface Photoelectric Effect. R. E. B. Makinson.** *Roy. Soc., Proc.* 162*A*. *pp.* 367–390, *Oct.* 1, 1937.—It is shown that, using the Sommerfeld model of a metal, a classical calculation of the field of an incident light wave (near the surface) gives to a close approximation the same results as the quantum theory of metallic reflection of Schiff and Thomas [see Abstract 3016 (1935)]. An expression is obtained for the photoelectric current arising at the surface of such a metal, taking account of the variation of the field of the light wave near the surface, on the lines of the theory given by Mitchell [see Abstract 2438 (1936)] in which this variation is neglected. The calculated emission for K is compared with recent experimental results at frequencies near the selective maximum; various suggestions are made as to the lack of close agreement found. The effect of small-scale roughness on an optically smooth surface is also briefly discussed. Errors are pointed out in the theories of Mitchell and of Schiff and Thomas. AUTHOR.

**4960. Theory of Total Reflection. C. Schaefer and Ruth Pich.** *Ann. d. Physik*, 30. 3. *pp.* 245–266, *Oct.*, 1937.—Picht's theory of total reflection [see Abstract 1402 (1930)], in which energy is allowed to pass to and fro across the plane of separation of the two media concerned, is modified to give results in closer relationship with experiment. A plane wave of limited extent is first considered, under the assumption that the incident amplitude is not constant but varies slowly in the plane of incidence in a direction perpendicular to the direction of propagation. The limited plane wave is then treated as the integral of plane waves with amplitude constant in space but with various directions of propagation, the results from the two treatments being shown to be consistent with one another. Total reflection of a plane wave limited both in extent and time is also considered. C. B. A.

**4961. Refraction Data and Reactivity of Halogenated Methane Derivatives. J. M. Stevels.** *Faraday Soc., Trans.* 33. *pp.* 1381–1390, *Oct.*, 1937.—According to Fajans and Joos the refraction is a measure for the electric field in which a certain ion lies, or, according to Wolf and Herzfeld, for the energy of the bond. Using the empirical formula of Fajans for the decrease of the refraction of an anion, it is sought to apply these considerations to the halogenated methane derivatives. In this way the course of the reactivity of hydrogen and halogen ions in organic compounds can be foreseen, as was found by Polanyi and co-workers. The values found also serve to explain the deviations of the calculated boiling points of the methane derivatives according to van Arkel and de Boer and give an insight into the regularities, which are found in the dipole moments for almost all halogenated aliphatic compounds. These two questions, however, are not treated here, but will be discussed in detail elsewhere. AUTHOR.

**0 4962. Optical Problems in Industrial Research. R. Kingslake.** *Journ. Sci. Instruments*, 14. *pp.* 289–296, *Sept.*, 1937.—Common optical problems are discussed in a practical way from the standpoint of "getting more light into an image." The fundamental equation for axial image illumination, $E = \kappa\pi B \sin^2\theta$, in terms of object brightness B, transmission factor $\kappa$, and extreme paraxial angle of image-field $\theta$, is applied to (i) the unaided eye, (ii) the iris and pupils of an optical system, (iii) the brilliance of optical images, (iv) the brightness of spectral lines, (v) the searchlight and (*vi*) the photographic camera, with special reference to distribution of illumination over the image plane. Among the practical devices considered are the two-lens projector system, galvanometer lamp and scale systems, projection in polarised light, use of field lenses to reduce vignetting effect (as in the telescopic rifle sight), use of lenses in tandem (necessity for common stop or diaphragm) and pinhole imagery. L. V. C.

**✱4963. Orthostereoscopy. H. F. Kurtz.** *J.O.S.A.* 27. *pp.* 323–339, *Oct.*, 1937.—The production of stereoscopic views characterised by correct

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" depth " relations and undistorted perspective can be accomplished only under rigorously prescribed relations between the several parts of the apparatus. These relations, in the form of a group of simple equations and accompanying diagrams, are developed and set forth. The characteristics of the apparatus resulting from the application of these relations are considered. AUTHOR.

*4964. **Orthostereoscopic Photomicrography. L. C. Martin and T. R. Wilkins.** *J.O.S.A.* 27. *pp.* 340–349, *Oct.*, 1937.—A method of orthostereoscopic photomicrography has been developed primarily for the purpose of the measurement of relative spatial angles of α-ray tracks and photographic emulsions. The conditions for obtaining the requisite perspectives from photographs made with a compound microscope system, and the necessary relations between the positions of an internal stop in the microscope, the shift of the object on the stage, and the mounting of the perspectives in a special form of Wheatstone stereoscope are discussed. A number of trial measurements with dry lenses and immersion microscope systems with magnifications ranging from × 100 to × 970 illustrate the application of the theory. The methods are applicable to other objects. AUTHORS.

*4965. **Stereoscopic Illustrations. F. C. Sauer.** *J.O.S.A.* 27. *pp.* 350–354, *Oct.*, 1937.—A modification of current graphical procedures is employed to produce a perspective picture of an object from measurements in three dimensions of points in the object. A stereoscopic mate for this drawing is readily constructed by the use of a simply ruled transparent sheet which gives directly the new location for each point. Particular attention is given to the preparation of anatomical illustrations. AUTHOR.

*See also* Abstracts 4786, 4835, 4922.

## SPECTROSCOPY.

4966. **Wave-Lengths in $H_2$ Spectrum from λ4225 to λ4756. N. A. Kent and R. G. Lacount.** *Astrophys. J.* 86. *pp.* 311–320, *Oct.*, 1937.—The wave-lengths of 435 lines of $H_2$ are measured on plates taken with a 21-foot concave grating at the California Institute of Technology. The results are compared with the measurements by Gale, Monk, and Lee, and Finkelnburg. [See also Abstract 219 (1937)]. AUTHORS.

4967. **Near Infra-Red Spectrum of Mercury. Part II. O. Masaki and T. Morita.** *Hirosima Journ. Sci.* 7. *pp.* 305–313, *Aug.*, 1937. *In English.*—In Part I [see Abstract 5131 (1936)] the near infra-red spectrum of Hg I to about 12000 Å was analysed by the photographic method. In the present research the Hg spectrum of the farther infra-red region, to about 14000 Å, was photographed. The plates used for this experiment were Eastman I-Z plates, which were super-sensitised by the method of heat treatment. Many new lines were found and their classification is given. AUTHORS.

4968. **Actinium Spectrum. (Miss) W. A. Lub.** *K. Akad. Amsterdam, Proc.* 40. 7. *pp.* 584–589, 1937. *In French.*—The visible and u.v. spectra are examined, using a spark between a Pt wire and gauze immersed in a solution of lanthanum oxide containing one part in 10,000 of Ac. Seven new lines between 4088 and 4812 Å are attributedto Ac and two further lines may arise from it. [See also Abstract 3086 (1937).] H. G. C.

4969. **Coupling of *p* Electron Configurations. H. A. Robinson and G. H. Shortley.** *Phys. Rev.* 52. *pp.* 713–723, *Oct.* 1, 1937.—The structure and type of coupling of the observed $p^2$, $p^3$, and $p^4$ configurations is considered in detail in terms of the intermediate-coupling theory, in particular for the long isoelectronic sequences which have recently been analysed. The theoretical values of the ratios of various intervals in these configurations are plotted as functions of the single parameter which specifies the type of coupling. The experimental values have been fitted to these curves and the parameters evaluated. The points fit the theoretical curves fairly well; and the departures of the experimental points of an isoelectronic sequence from these curves are sufficiently regular to enable accurate prediction of unknown levels. This method has yielded new classifications in K IV and Ca VII. For the configurations $p^3$ and $p^3s$ interval ratios are found which are predicted to be entirely independent of coupling. The parameters are plotted for the isoelectronic sequences of $sp$, $p$, $p^2$, $p^3$, $p^4$, $p^5$, and $p^5s$ configurations. The electrostatic interaction parameter $F_2$ is found to be a linear function of Z to a good approximation; the spin-orbit parameter $\zeta_p$ is accurately proportional to $(Z - S)^4$ for all but the first few members of each sequence. The screening constants (S) for $\zeta_p$ are much smaller than the corresponding screening constants for $F_2$. A complete Bibliography of data for those atoms with $p$ electrons in the normal configuration is appended. [See following Abstract.] AUTHORS.

**4970. Additions to Spectra of S, K, and Ca. H. A. Robinson.** *Phys. Rev.* 52. *pp.* 724–725, *Oct.* 1, 1937.—Twenty-seven lines have been classified in S III. These locate 6 of the important singlet levels accurately with respect to the known triplets. S VI is completely revised. Fourteen new terms have been added which classify 18 new lines. The revised ionisation potential is 87·610 ± 0·003 V. Two new singlet terms with intercombinations have been found in K VI and Ca VII. One new singlet term has been added to K IV and three terms to S VIII. Several of these last few spectra have been investigated in order to tests the conclusions drawn from the previous paper [see preceding Abstract]. AUTHOR.

**4971. Structure of D-Terms of Sodium Arc Spectrum. K. W. Meissner and K. F. Luft.** *Preuss. Akad. Wiss. Berlin, Ber.* 12. *pp.* 118–124, 1937.—A Fabry-Perot etalon with separations of up to 18 cm. is applied to the exact measurement of wave-lengths with high resolution in the Na arc spectrum excited by electron collisions in a Na atomic beam. Four $m^2$D terms, $m = 3, 4, 5$ and 6, are found to have inverted arrangement. Accurate values are derived and tabulated for these $^2$D terms and also for the $3^2P_{3/2}$, $3^2P_{1/2}$ and $3^2S_{1/2}$ to $7^2S_{1/2}$ terms. J. E. K.

**4972. Bergmann Series of Calcium. H. Grafenberger.** *Ann. d. Physik*, 30. 3. *pp.* 267–283, *Oct.*, 1937.—An exact determination of the Bergmann series of Ca has been made. A light source, giving very sharp lines of high intensity by means of the h.f. excitation of Ca vapour with a short-wave transmitter is described. The structure of the $^3$F terms of CaI is determined. They are regular triplet terms with normal, constant separations. A. J. M.

**4973. Relative Transition-Probabilities in the Bergmann Series of Calcium. E. Katz and L. S. Ornstein.** *Physica*, 4. *pp.* 757–760, *Oct.*, 1937. *In English.*—The relative intensities of the Ca-Bergmann-lines ($m^3F - 3^3D$) in a thermic arc, the temperature of which was known from CN-bands or from lines of known transition probabilities, are determined. The relative transition probabilities A deduced from these data satisfy the relation $A.m^{4\cdot 35} = \text{const.}$, except the first triplet, which has an A-value 38% lower than given by this relation. AUTHORS.

**4974. Quantitative Relation between Magnetic Moments of Atomic Nuclei. H. Schüler.** *Zeits. f. Physik,* 107. 1–2. *pp.* 12–14, 1937.—This paper comprises a preliminary report of the discovery of a quantitative relation between magnetic nuclear moments, a discussion of the deeper significance of which is reserved for a subsequent detailed report. The relation, which has reference only to the heavy nuclei with odd numbers of protons, is $\frac{\mu_{\text{core}}}{\mu} = \text{constant} = 0\cdot 38$ where $|\mu_{\text{core}}| = |\mu_r - \mu|$, $\mu_r$ is the magnetic moment of the odd proton $\mu_r = \mu_{r_1} \pm \mu_{r_2}$ and $\mu$ is the largest or smallest magnetic moment of the complete nucleus corresponding to any particular mechanical moment $i$, regarded as compounded only from orbital and spin moments, *i.e.*, $i = P_l$(orbital) $\pm P_s$(spin). The relation $|\mu_{\text{core}}| = |\mu_r - \mu|$ is based on the author's previously communicated conception of the nuclear magnetic moment as being the sum of the magnetic moments of the odd proton and the atomic core. J. E. K.

**4975. Electric Quadrupole Moment of In$^{115}$. R. F. Bacher and D. H. Tomboulian.** *Phys. Rev.* 52. *pp.* 836–839, *Oct.* 15, 1937.—Measurements of the lines λ7852 ($5s6p\,^1P \rightarrow 5s6s\,^1S$) are λ8241 ($5s6p\,^1P \rightarrow 5s5d\,^1D$) of In II show deviations from interval rule. These deviations are satisfactorily accounted for by the presence of a nuclear electric quadrupole moment which from the first of the lines is found to be $Q = 0\cdot 82 \times 10^{-24}$ cm$^2$. No trace of lines due to In$^{113}$ was found.

AUTHORS.

**4976. Electron Affinities and Valency States. H. Hellmann and M. Mamotenko.** *Acta Physicochimica,* 7. 1. *pp.* 127–147, 1937. *In German.*—By introducing a variation parameter in the Slater theory of complex spectra, simple extrapolation formulæ are obtained for the terms of an atom and its ions, and for isoelectronic systems of various atoms. This interpolation method is applied to the determination of the electron affinities of F, O, N and C and to a new determination of the energies of their valency states. C. B. A.

**4977. Multiplet Structure in a Crystalline Electric Field of Cubic Symmetry. G. J. Kynch.** *Faraday Soc., Trans.* 33. *pp.* 1402–1418, *Oct.,* 1937.—The patterns of all J-levels are given for the rare-earth ions in crystalline electric fields of cubic symmetry, either of the sixth order or of the fourth order, together with the constants necessary to evaluate the levels in particular cases. The combination of the two fields appropriate to an octahedral field due to six point charges is then obtained and applied to the ground levels of these ions. In the subsequent discussion it is shown that the experimental results for the hydrated sulphates of the rare-earths cannot be satisfactorily explained on the assumption of a cubic field although this assumption may be satisfactory for other crystals. In addition, some general theorems on the matrix elements of crystalline potential energies and on the inversion of the patterns of complimentary configurations are proved. AUTHOR.

**4978. Near U.V. Absorption Spectrum of Diacetylene. Part II. Sho-Chow Woo and T. C. Chu.** *J. Chem. Phys.* 5. *pp.* 786–791, *Oct.,* 1937.—The absorption spectrum of diacetylene has been reinvestigated with an instrument of higher dispersion. The bands in the region 2970–2650 Å are sharp and narrow, and very closely spaced. Two progressions with a frequency difference ~690 $cm^{-1}$. have been found. Those below 2650 Å are very diffuse, but with a comparatively simpler gross structure. Ten progressions all with a frequency difference ~2100 $cm^{-1}$. have been found. Through a brief and qualitative discussion of the normal vibrations and symmetry properties of the molecule, the frequency differences ~2100 $cm^{-1}$. and ~1900 $cm^{-1}$. are respectively ascribed as the totally symmetrical $\nu'_{c\equiv c}(s)$ and unsymmetrical $\nu'_{c\equiv c}(a)$ longitudinal frequencies in the excited state. The frequency ~635 $cm^{-1}$ is assigned as one of the fundamental frequencies in the normal state, since bands with this frequency difference were relatively intensified at higher temperatures. [For Part I see Abstract 4260 (1935).] AUTHORS.

**4979. Absorption of Hydroxy-Compounds in the Region of 3μ. J. J. Fox and A. E. Martin.** *Roy. Soc., Proc.* 162*A*. *pp.* 419–441, *Oct.* 1, 1937.—The two OH absorption bands near 3μ for phenol and certain alcohols have been investigated for solutions in $CCl_4$ and other solvents. With phenol the intensity of the longer wave " association band " varies as the number of molecules not contributing to the short-wave band. The association band is complex and its maximum moves to shorter wavelengths as its intensity falls. Increasing molecular complexity in the series $PhCH_2OH$, $Ph_2CHOH$ and $Ph_3COH$ causes a small progressive increase in the wave-length of the short-wave OH band; when $CCl_4$ is replaced by $CHCl_3$ as solvent this band is displaced to a slightly longer wavelength. The structure of the molecule itself may affect the magnitude of the association band, *e.g.*, the presence of three phenyl groups in triphenylcarbinol almost suppresses association. Aliphatic CH bands for CH,$CH_2$ and $CH_3$ groups are examined and it is shown that there is a constant intensity of absorption for the CH linkage in each molecule. Aromatic CH bands retain their positions, but not necessarily their relative intensities, for a series of aromatic alcohols. A. H.

***4980. Spectra of $N_2$ and CO in the Lyman Region. W. M. Tschulanowsky and S. I. Gassilewitsch.** *Phys. Zeits. d. Sowjetunion,* 12. 1. *pp.* 83–88, 1937. *In German.*—An improved spectrograph, with a resolving power of 40,000 with 2-hr. exposures, is described for investigations in the Lyman region of the spectrum. Preliminary values obtained for 27 previously unrecorded bands of CO are tabulated, and the molecular spectrum of $N_2$ is discussed. C. B. A.

**4981. Absorption Spectra of Metal Complexes of 2, 2′-Dipyridyl. K. Yamasaki.** *Chem. Soc. Japan, Bull.* 12. *pp.* 390–394, *Aug.,* 1937. *In German.*—Visible and u.v. absorption spectra are recorded for aqueous and alcoholic solutions of the complex tri-dipyridyl salts of divalent Cu, Zn, Ni, Fe and Co and of trivalent Co at ordinary temperatures, and the visible bands are also studied at liquid-air temperature. C. B. A.

**4982. New U.V. Absorption Bands of Sodium and Potassium Molecules. H. Yoshinaga.** *Phys. Math. Soc., Japan, Proc.* 19. *pp.* 847–859, *Sept.,* 1937. *In English.*—New absorption bands found in this work showed, when subjected to vibrational analysis, five systems for $K_2$ molecules in the region between 4160 and 3480 Å, and one system for $Na_2$ molecules in the region between 2750 and 2550 Å. Occurrence of these bands is due to the transition from the normal state to the newly found states of each molecule. Close similarity is clearly seen among newly found $K_2$ bands and those of $Na_2$ and $Li_2$ which were already observed in the u.v. region. AUTHOR.

**4983. Flame Spectra of Aliphatic Halides. Part I. W. M. Vaidya.** *Indian Acad. Sci., Proc.* 6*A*. *pp.* 122–128, *Aug.*, 1937.—The spectrum of the flame of $CH_3I$ burning both with air and $O_2$ has been found to include a number of bands which do not seem to have been observed before. Tables of their wave-lengths and analysis are given. It has been shown from the analysis that the bands belong to two systems with one electronic level common to them. The emitter of the bands is not definitely known but there are reasons to believe that they may be due to IO. Author.

**4984. Rotational Analysis of 0 → 4, 0 → 5, 1 → 4, and 1 → 5 Band of the Third Positive System of CO. B. S. Beer.** *Zeits. f. Physik*, 107. 1–2. *pp.* 73–85, 1937.—The rotational analysis of the $b\,{}^3\Sigma \rightarrow a\,{}^3\Pi$ bands of CO is carried out and the nature of the perturbation estimated. Characteristic constants are calculated. W. R. A.

**4985. Spin Doubling in $^2\Sigma$ States of AlO. M. K. Sen.** *Indian Journ. Phys.* 11. *pp.* 251–281, *Sept.*, 1937.—From high dispersion spectrograms, the existence of spin doubling in both the upper and lower, $^2\Sigma$, states of the band system of AlO has been ascertained. In addition to (1, 0), (0, 0) and (0, 1) bands, which were previously analysed by Pomeroy [see Abstract 1391 (1927)] the structure analysis of the bands (2, 1), (1, 1) and (1, 2) has been carried out. The values of the rotational constants are in good agreement with the data of Pomeroy. Author.

**4986. $^1\Sigma^*$–$^1\Sigma$ Band System of Ionised Zinc Deuteride. J. W. Gabel and R. V. Zumstein.** *Phys. Rev.* 52. *pp.* 726–727, *Oct* 1, 1937.—The $^1\Sigma^*$–$^1\Sigma$ bands have been photographed with a dispersion of about 1 Å/mm. Five bands of the system between λ2300 and λ2100 were analysed. The isotopic coefficient ρ is in satisfactory agreement with the value obtained from atomic weights. The electronic isotope displacement of 6 $cm^{-1}$., relative to $Zn^+H$, is probably due to the small number of vibrational levels; three for each state of the molecule. A fine structure due to the zinc isotopes was indicated by a diffuseness of the lines. Authors.

**4987. Emission Spectrum of Diatomic Arsenic. Part II. G. D. Kinzer and G. M. Almy.** *Phys. Rev.* 52. *pp.* 814–821, *Oct.* 15, 1937.—The emission spectrum of $As_2$, previously studied in the interval 2100 to 3700 Å, has been extended to 7000 Å. The two prominent systems have been greatly extended so that the ground state of the molecule has been followed to $v = 70$, in energy to nearly 0·8of the heat of dissociation. $D(X).D(X)$ is 3·9 V by extrapolation and the same value is obtained from analysis of predissociation occurring in the two most prominent systems. Two new systems have been found, one having the same lower state as those previously reported and the other forming a double array. The latter has been tentatively assumed to be due to $As_2^+$. [For Part I see Abstract 2570 (1935).] Authors.

**4988. Molecular Spectrum of Hydrogen in Mixtures of $H_2$ and He. N. D. Smith.** *Phys. Rev.* 52. *pp.* 728–730, *Oct.* 1, 1937.—The anomalous rotation discovered by Richardson in the molecular spectrum of $H_2$ mixed with He was investigated. He was found to decrease vibration and increase rotation of the (0–0) bands in agreement with the results of O. W. Richardson and A. S. Roy. For high pressures of He (400 mm.) the rotation was also reduced. At liquid-air temperature the anomalous rotation was less marked than at room-temperature.

No anomalous rotation was observed in the (3–3) and (2–2) bands. These results agree with the process proposed by O. Oldenberg in which collisions between an excited $H_2$ molecule and He atoms change part of the vibration of the $H_2$ molecule into rotation. [See also Abstract 1689 (1936).] AUTHOR.

**4989. Rotation and Vibration of Linear Triatomic Molecules. A. Weinberg and C. Eckart.** *J. Chem Phys.* 5. *pp.* 517–522, *July*, 1937.—The definition of the rotating axes for the triatomic case can be based on the fact that the 3 atoms always define a plane. The relation of this definition to that for non-linear molecules is discussed, and the appropriate normal coordinates are introduced. The wave-equation of the problem is derived, and an approximate solution discussed. Since the Eulerian angles do not enter into the zero or first-order terms of the Hamiltonian, it is possible to calculate some of the second-order terms for the energy values with complete generality. These are the terms arising from rotation, and from coupling between rotation and vibration. If the natural frequencies are commensurable, the derivation ceases to be valid, but it is probable that the result is the same, nevertheless. A. C. M.

**4990. Eigen-Vibrations of Tetrahedral Molecules. E. A. Hylleraas.** *Zeits. f. Physik*, 107. 1–2. *pp.* 86–90, 1937.—Characteristic eigen-vibrations and corresponding eigen-frequencies are found for tetrahedral molecules of the type $AB_4$, assuming a central force system between the central A atom and the B atoms and between the B atoms. W. R. A.

**4991. Bond Force Constants and Vibrational Frequencies of Hydrocarbons. G. Glockler and F. T. Wall.** *J. Chem. Phys.* 5. *pp.* 813–817, *Oct.*, 1937.—By use of valence forces, the normal coordinate method of treating vibrations has been applied to a number of related molecules and 29 frequencies have been calculated and compared with experiment. The molecules considered are methylacetylene, dimethylacetylene, acetylene, diacetylene, ethane and methane. The frequencies calculated include all of the non-degenerate frequencies for the above molecules and the degenerate frequencies of methane. A set of five force constants has been applied to all of the molecules with fairly good results. The calculations have been carried out for both liquids and gases, a slightly different set of force constants being assigned to each state of aggregation. AUTHORS.

**4992. Interaction in Molecules between Rotation and Slightly Anisotropic Oscillations. H. H. Nielsen.** *J. Chem. Phys.* 5. *pp.* 818–822, *Oct.*, 1937.—The problem of the interaction between rotation and oscillation in two-dimensionally slightly anisotropic molecules is considered quantum-mechanically on the basis of a model rotating only about an axis normal to the plane in which the oscillations take place. The energy of the molecule in the ground state becomes $(h/2)(\nu_1 + \nu_2) + K^2h^2/8\pi^2A$, while for the upper states the energies are $E = h(\nu_1 + \nu_2) + (K^2 + \zeta^2)h^2/8\pi^2A \pm ((\Delta\nu/2)^2 + (Kh/4\pi^2A)^2\zeta^2)^{\frac{1}{2}}$, where $\zeta$ is a quantity depending upon the normal coordinates which in general is not an integer. The selection rules are such as to enhance the intensities of the set of lines in the sides of the two bands adjacent to each other at the expense of the set of lines in the sides of the bands farthest away from each other. The spacings between rotational lines of the first set converge rapidly towards a limiting value of $(1 - \zeta)h/4\pi^2A$, while for the other set the spacings approach a value $(1 + \xi)h/4\pi^2A$. [See following Abstract]. AUTHOR.

**4993. Two Bands in the Infra-Red Spectrum of Formaldehyde. E. S. Ebers and H. H. Nielsen.** *J. Chem. Phys.* **5.** ***pp.*** **822–827,** ***Oct.*,** **1937.**—Two infra-red bands of the type arising from oscillations of the electric moment normal to the axis of symmetry have been measured under high dispersion and identified as the two oscillations which are at right angles to each other and which is Sutherland and Dennison's notation are $\nu_5$ and $\nu_6$. Their centres are respectively at 1278 $cm^{-1}$. and 1165 $cm^{-1}$. The anomalous spacing between the principal rotation lines is accounted for on the basis of an interaction between rotation and the two oscillations which are only slightly anisotropic. [See preceding Abstract]. AUTHORS.

**4994. Transfer of Rotational Energy in Molecular Collisions. Part II. Exchange of Energy in Collisions Between Unexcited HgH and $N_2$ Molecules. F. F. Rieke.** *J. Chem. Phys.* 5. *pp.* 831–835, *Oct.*, 1937.—It has been found that the intensity distribution in the HgH 4017 band excited by sensitised fluorescence in the mixture Hg + $H_2$ + $N_2$ is influenced by the intensity of the primary light which excites the fluorescence. This observation may be interpreted as evidence of a very slow exchange of vibrational energy in collisions between $N_2$ and HgH molecules in their normal electronic states. Two other possible causes of the phenomenon—self-reversal and reactions involving high energy Hg atoms formed by stepwise excitation—are ruled out by additional experiments. [For Part I see Abstract 4218 (1936)]. AUTHOR.

**4995. Absorption Spectrum of Liquid Bromine. D. Porret.** *Roy. Soc., Proc.* 162*A*. *pp.* 414–419, *Oct.* 1, 1937.—The absorption spectrum of liquid $Br_2$ has been measured between 12,000 and 40,000$cm^{-1}$. In the region of the maximum, the measurements have been made by a new method, giving more accurate results than have been previously obtained. The extinction coefficient curve is compared with those of gaseous $Br_2$ and of the $CCl_4$ solution. An interpretation of the difference between the three states is attempted. AUTHOR.

**4996. Zeeman Effect of Rare Gases. J. B. Green.** ***Phys. Rev.*** **52.** ***pp.*** **736–738,** ***Oct.*** **1, 1937.**—The *g* values of the neutral rare gases have been calculated from the atomic coupling factors for the $np^5n'p$ configurations, and excellent agreement is shown to exist between theory and experiment in most cases. From curves of the *g* values, interesting conclusions regarding the genealogy of the terms in these configurations are noted. AUTHOR.

***4997. Stark Effect in Iron and its Contrast with the Pole Effect. S. F. Panter and J. S. Foster.** *Roy. Soc., Proc.* **162*A*.** ***pp.*** **336–348,** ***Oct.*** **1, 1937.**—A modified lo Surdo discharge tube has been designed suitable for investigations of Stark effects in the spectra of metals of high melting points. The Stark effect in the arc spectrum of Fe has been observed in the region 6500–3400 Å at a number of field-strengths ranging from 100,000 to 200,000 V/cm. 225 lines were photographed, 33 of which were found to be displaced. The Stark effect consists of simple small displacements of the lines. Some polarised components were observed. The relation between the pole effect and the Stark effect is discussed, and the conclusion drawn that the pole effect cannot be identical with the Stark effect as has been assumed by many writers. Stark displacements of lines not yet examined are predicted from the known effects on 98 initial terms. A general theoretical explanation of the observations requires the introduction of hitherto unknown odd terms of specified values. AUTHORS.

*4998. **Stark Effect in Hydrogen and Deuterium. J. S. Foster and H. Snell.** *Roy. Soc., Proc.* 162*A*. *pp.* 349–356, *Oct.* 1, 1937.—The Stark effects for $H_\alpha D_\alpha$, $H_\beta D_\beta$, $H_\gamma D_\gamma$ and $H_\delta D_\delta$ have been photographed from a lo Surdo source containing a mixture of the isotopes. The observed asymmetric Stark intensity patterns for $D_2$ are nearly the mirror images of those for $H_2$. Somewhat similar results are obtained with a new canal-ray tube which operates at pressures much higher than usual. These effects are attributed mainly to selective absorption with the source. Variations from the Epstein spacing of components are found to be in fair agreement with the Schlapp theory of the fine structure of the Stark effect. The observations confirm earlier researches on $H_2$, and are extended to include $D_2$. AUTHORS.

4999. **Stark Effect in Hydrogen. M. Kiuti and H. Hasunuma.** *Phys. Math. Soc., Japan, Proc.* 19. *pp.* 821–834. *Sept.*, 1937. *In English.*—It is attempted to explain the Stark effect in $H_2$ from the view-point of theory, *i.e.*, by the interactions of even and odd levels in the electric field. The relative positions of the interacting levels, which are known only roughly from the band analysis, are determined by the examination of the effects on lower states. $2p^3\Pi(v \doteq 0\ K = 4,\ a)$ is to lie $8 \cdot 0$ cm$^{-1}$. higher than $2s^3\Sigma(v = 0\ K = 3,\ a)$. The effect on the 2–2 bands of $a$ are well accounted for, at least qualitatively. AUTHORS.

5000. **Intensities of the Stark-Effect Components of Hydrogen in Strong Electric Fields. T. Gustafson.** *Zeits. f. Physik*, 106. 11–12. *pp.* 709–729, 1937.—Schrödinger calculated the intensities of the Stark-effect components of H from the unperturbed eigenfunctions. Here the intensities for $H_\beta$ are calculated to the first approximation by the method of variation of the constants from the perturbed equations. The symmetrical violet and red components are found to show an intensity difference which for a field-intensity of 500 kV/cm. lies between $5 \cdot 6$ and $10 \cdot 7\%$ for the four strong lines. For some pairs of lines the violet and for others the red line is stronger. Weak lines remain weak. For two eigenfunctions the calculations were taken to the second approximation as a check. W. S. S.

5001. **Connection between Fluorescence and Absorption Bands and the Raman Effect. G. B. Banerjea and B. Mishra.** *Zeits. f. Physik*, 106. 11–12. *pp.* 669–674, 1937.—Photometric measurements are made of the absorption and fluorescence bands of anthracene in various organic solvents. Assuming the absorption bands to correspond to the "exciting line" and the fluorescence bands to the "Raman effect," the wave-number differences are determined. These differences are claimed to agree with some of the Raman shifts of the solvents as determined in the usual manner. A. C. M.

5002. **Chemical Application of the Raman Effect. J. H. Hibben.** *Washington Acad. Sci., J.* 27. *pp.* 269–299, *July* 15, 1937.—An address, in which the interpretation, development and application of Raman spectra are outlined, and an analysis of the data upon which such interpretations and applications are based. A. C. M.

5003. **Raman Spectrum of $D_2O_2$ and $HDO_2$. F. Fehér.** *Zeits. f. Elektrochem.* 43. *pp.* 663–664, *Aug.*, 1937.—The Raman spectra of $H_2O_2$, $HDO_2$, and $D_2O_2$ are compared. One frequency (877 cm$^{-1}$.) occurs in all three, and is therefore attributed to a valence vibration of O against O. Two frequencies (3395 and 1421 cm$^{-1}$.) in $H_2O_2$ correspond to two others (2510 and 1009 cm$^{-1}$.) in $D_2O_2$, and since the ratio is approximately $\sqrt{2}$, they are attributed to H and D vibrations respectively, the smaller in each case being regarded as due to a deformation vibration. The spectrum of $HDO_2$ is additive from those of $H_2O_2$ and $D_2O_2$. A. C. M.

**5004. Raman Spectra of Acetic Acid, Bromoform and Cyclohexane. A. I. Sidorova.** *Acta Physicochimica,* 7. 2. *pp.* 193–200, 1937. *In English.*—The spectra of the light scattered by the liquid and by monocrystals of the substances are examined. The wings shown by liquid bromoform and acetic acid correspond to lines in the spectra of the solids. In cyclohexane the wings are absent in the liquid and the lines in the solid. The wings are attributed to vibrations due to a partially retained crystal structure in the liquid. The Raman spectrum of the crystal of acetic acid shows a series of lines not present in the liquid.
H. G. C.

**5005. Free Rotation in the Oxalate Group and the Resonance Bond of Carboxyl. J. Gupta.** *Indian Journ. Phys* 11. *pp.* 231–238, *Sept.,* 1937.—The existence of axial rotation of the oxalate group about the C — C axis, postulated in a previous paper [see Abstract 1692 (1937)] is confirmed by showing that the sharp Raman line at 1300 wave-numbers observed in the spectra of the oxalates in solution, which is "forbidden" in the Raman effect if the ion remains rigidly planar, is totally absent in the spectra of the solids where the ion is known to remain planar in several oxalates from results of X-ray analysis. The hypothesis of free rotation is preferred to a limited axial oscillation about the $V_h$ configuration. The band at 1620 wave-numbers is identified with the anti-symmetric vibration $\omega_1$ of the ionised carboxyl group, and connecting this with the crystal structure data for the O—C—O angle, the value of the resonance bond (C—O) is calculated. The value is intermediate between single and double bond values, but approaches more towards the single bond. AUTHOR.

**5006. Raman Spectra of Borneol and Camphor. B. V. Thosar and B. K. Singh.** *Indian Acad. Sci., Proc.* 6*A*. *pp.* 105–111, *Aug.,* 1937.—The Raman spectra of the *d*, *l*, and *dl* forms of borneol and of camphor have been studied in the crystalline state. The spectra of *dextro* and *lævo* forms in both cases are identical, thus supporting Pasteur's law of molecular dissymmetry. The Raman spectra of the *dl* forms of borneol and camphor are also the same as those of their optically-active isomers. This supports the view already derived from measurements of viscosity that the *d* and *l* components in a racemic compound are very loosely bound. The most intense shifts in these compounds are those associated with C–H vibrations. An intense and sharp line occurs at about 650 $cm^{-1}$. in both camphor and borneol, and is ascribed to the neopentyl group. AUTHORS.

**5007. Absorption Step-Weakeners of Antimony. G. O. Langstroth and D. R. McRae.** *Canad. J. of Research,* 15. *Sect. A. pp.* 154–160, *Sept.,* 1937.—It is of advantage to the spectroscopic analyst to have a means of quickly preparing a step-weakener of any required characteristics. A method has been developed in which Sb films are deposited by thermal decomposition of the trihydride. The apparatus required is simple, and a multi-step weakener may be made in 20 min. The films are nearly neutral below 4000 Å. Their optical density is quite uniform, and they are sufficiently strong for all practical purposes. For high precision work, the construction of the weakener must be such that undesirable interference effects are avoided. A consideration of the theory of interference phenomena in light transmitted through thin plates suggests several possible methods of construction. Some of these have been adopted and have been found to be satisfactory in practice. AUTHOR.

**5008. Light Absorption in Chemical Analysis. H. Fromherz.** *Zeits. f. Elektrochem.* 43. *pp.* 791–796, *Oct.*, 1937.—A general account, with examples, of the use of absorption measurements for the determination of the concentration of absorbing substances and for the investigation of chemical constitution. L. A. W.

*See also* Abstracts 4752, 4774, 4927, 5032.

## VELOCITY OF LIGHT.

*See* Abstract 4957.

## X-RAYS.

***5009. Million-Volt X-Ray Generator. J. G. Trump and R. J. van de Graaff.** *J. of Applied Physics,* 8. *pp.* 602–606, *Sept.*, 1937.—An electrostatic generator has been built in which initial charges of 20 kV applied to a moving belt build up to as much as 1·2 million volts on an insulated conductor at the top of the belt run. The output to the X-ray tube is 3 mA, the tube being of cascade form and comprising 20 porcelain cylinders, mounted vertically, and being 10 ft. high. The upper end is in contact with the live terminal of the generator. The target is of lead and is water-cooled, the tube being lead shielded to a maximum of 3 in. The filament is mounted 16 ft. above the target and the electrostatic screens focus the beam, which is further magnetically focused, to a final diameter on the target of from ¾ in. to ⅛ in., depending on the current in the electromagnetic deflecting coils. The tube is continuously evacuated and the total load is about 15 kW. The installation is at Boston, Mass. Outline diagrams are given. E. H. W. B.

**5010. Absorption of Moderately Swift Kathode Rays and Soft X-Rays in Oxygen. F. I. Callisen.** *Zeits. f. Physik,* 107. 1–2. *pp.* 15–43, 1937.—The filtered K$\alpha$ rays of Fe, Ni, Cu, Zn and Sn were employed to generate photoelectrons in an atmosphere of $N_2$ and their absorption coefficients were measured by the pressure variation method. In the velocity region $0{\cdot}1<\beta<0{\cdot}3$ the absorption coefficients found are in agreement with the diffusion theory of electron absorption. For $\beta = 0{\cdot}3$ the value obtained is in close agreement with the value found by Lenard and his collaborators for air and Al. For the wave-length region $1{\cdot}4<\lambda<1{\cdot}9$ Å. the coefficient of weakening of X-rays for $O_2$ was determined and found to agree with previously published values. They follow the law $\mu/\rho = 3{\cdot}02\lambda^3 + 0{\cdot}16$. A description is given of a simplified difference filter arrangement for measurements with homogeneous X-rays. A. W.

**5011. Effect of X-Rays on Colloidal Carbon. J. A. Crowther, H. Liebmann and T. B. Lane.** *Phil. Mag.* 24. *pp.* 654–664, *Oct.*, 1937.—The results recorded seem to establish the fact that quite small exposures to X-rays produce a significant change in the $\zeta$ potential of a colloid particle, and that the potential shows alternate maxima and minima as the exposure is uniformly increased. No explanation is offered for the phenomenon. It has, however, been possible to test whether the effect is due to a large change in $\zeta$ potential of a few particles or whether all the particles are more or less equally affected by the radiation. If the change in the average mobility is due to the presence of a small number of particles with excessively high or low mobilities the scatter of the individual mobility readings should be greater for the irradiated sol than for the stock. To test this point a graphite sol was given an exposure of 27 r. (for which the effect is a maximum) and nine complete sets of twenty individual readings were made. The coefficient of variation of these 180 readings was calculated and compared with that of a similar set of readings for the unexposed sol, with the following result:—Coefficient of variation of unexposed sol, 7·98 ± 0·84 (S.E.); Coefficient of variation of irradiated sol, 8·671 ± 0·6 (S.E.). There is a small difference between the two estimates, but it is not significant. It would appear that all the particles are more or less equally affected by the radiation. AUTHORS.

**5012. X-Ray Dispersion Spectra. H. Seemann.** *Phys. Zeits.* 38. *pp.* 683–688, *Sept.* 15, 1937.—The sharpness of Mo-K lines when subjected to refraction by quartz is different according as to whether the beam enters or leaves the quartz at a glancing angle. The phenomenon is studied practically and theoretically. The refraction produced by the addition of a thin sheet of glycerin is also discussed. J. T.

**5013. X-Ray Interference in Lattice Sources. W. Kossel.** *Ergeb. d. exakt. Naturwiss.* 16. *pp.* 295–352, 1937.—Gives a detailed account of the recent experiments on the interference patterns which are obtained from crystal lattices when the X-rays originate in the lattices themselves. These X-rays may be excited either by kathode-rays or by other X-rays, when a Laue diagram will also be produced. A mathematical discussion based on the conception of the reciprocal lattice is given, and it is shown how a complicated system of rings and lines will be obtained on the recording film. Questions of intensity are also discussed. As regards experimental results it is pointed out that light elements cannot give these effects and that the lightest elements capable of producing results are those of about the weight of Cl. Results have been obtained from Cu, $Fe_3O_4$, $SrCO_3$, ZnS, and other materials. An account is also given of the factors influencing the breadth of the lines and the effect of a mosaic lattice. G. G.

**5014. Successive X-Ray Crystal Reflections to Obtain Increased Resolving Power. J. W. M. DuMond.** *Phys. Rev.* 52. *pp.* 872–883, *Oct.* 15, 1937.—If an X-ray beam is selectively reflected from more than two crystal surfaces in succession it is shown in this paper by a simple method of graphical analysis that it should be possible to obtain resolving power considerably superior to the best obtainable with present two-crystal X-ray spectrometers. This extension and generalisation of the two-crystal spectrometer principle in one of its forms (the three-crystal spectrometer) should permit the study of the asymmetric diffraction patterns predicted by the theory of Prins but heretofore considered to be completely beyond experimental investigation. In another form (the four-crystal spectrometer) a distinct improvement in spectral resolving power is anticipated. The new method of graphical analysis invented for the purpose of discussing these more complicated cases of polycrystalline X-ray reflection is conspicuously useful and clear as a help to understanding the two-crystal spectrometer also. An experimental test of these new methods is now in progress. AUTHOR.

*See also* Abstract 4939.

## HEAT.

### CALORIMETRY.

**5015. Atomic Heat of Aluminium from 1·1 to 20° K. J. A. Kok and W. H. Keesom.** *K. Onnes Lab., Leiden, Comm. No.* **248e.** *Physica,* **4.** *pp.* 835–842, *Oct.*, 1937. *In English.*—It appears that above the normal transition point from the supraconductive to the non-supraconductive state the atomic heat can be represented by $C_v = D\,(419/T) + 0{\cdot}0003484\,T$ cal./deg. mol. Discussion shows that the density of the energy levels at the limiting energy at $T = 0°$ K. is 2·1 times the density corresponding to the 3 *p*-electrons if they were perfectly free. Susceptibility data would suggest a heat capacity of the conduction electrons of 0·000306 T, which is of the same order of magnitude as the observed value (0·0003484 T). Below the transition point the atomic heat of Al has a higher value than that given by our formula. The atomic heat at the transition point suffers a jump from 0·00089 to 0·00043 cal./deg. mol., which corresponds to a value of $dH/dT = 143$, as calculated by means of Rutgers' formula. [See also Abstract 3786 (1934).] AUTHORS.

***5016. Specific Heat Determinations by Eddy-Current Method. Part I. R. M. Davies and W. J. Thomas.** *Phil. Mag.* **24.** *pp.* 600–633, *Oct.*, 1937.—In order to investigate the possibility of a method for the the determination of specific heats in which the heat is supplied to the specimen inductively, a theoretical study is made of the eddy-current losses in plates and cylinders. Various assumptions are introduced, so exact solutions are not obtained. From an analysis of these solutions it is possible, however, to obtain useful information regarding the best type of specimen for the specific heat determination, and other conditions to be satisfied in the design of the apparatus. R. W. P.

*See also* Abstract 5039.

### CONDUCTION.

**5017. Energy Exchange between a Gas and Solid Surfaces. J. M. Jackson and H. Tyson.** *Manchester Phil. Soc., Mem.* **81.** *pp.* 87–102, *Aug.*, 1937.—The problem of the exchange of energy between a gas and a solid surface is examined using a potential field of the type $V(x) = V_0[(\epsilon^{-ax}/a)-(\epsilon^{-bx}/b)]\,ab/(a-b)$, and London's perturbation theory instead of Born's collision theory. In making the evaluation a differential analyser is used, and the results are calculated for the case of Ne and W, with $V_0 = 2000$ cal./gm. mol.; $a = 3$ Å$^{-1}$ and $b = 1$ Å$^{-1}$. The contribution made to the accommodation coefficient by the transitions between the free states of the gas atoms is small, calculated values for this effect being about one-sixth of the experimental values and the variation with temperature differing. When an estimate for the contribution arising from the transition during the time an atom is absorbed on the surface is also included fair agreement with experiment is obtained. A comparison is made between the results of this analysis and of that recently carried out by Devonshire [see Abstract 406 (1937).] R. W. P.

**5018. Heat Conduction by Rarefied Gases. Part III. Thermal Accommodation Coefficient of He, Ne and $H_2$ on Glass at 12–20° K. W. H. Keesom and G. Schmidt.** *K. Onnes Lab., Leiden, Comm.*

*No.* 250*a*. *Physica*, 4. *pp.* 828–834, *Oct.*, 1937. *In English.*—The results are consistent with those found in the region 70°–90° K. They confirm that for Ne and Hg the thermal accommodation coefficient $a_{1,\infty}$ would be $= 1 \cdot 00$ in the region 12–20° K. where both gases are considerably adsorbed by the glass surface. The exactness of Knudsen's theoretical formula for the molecular heat transports is proved. For He $a_{1,\infty}$ appears to have considerably increased, *viz.* from 0·383 at 77° K. to 0·57 at 18° K. and 0·67 at 12° K. There is every reason to expect that $a_{1,\infty} = 1 \cdot 00$ for $T < 5 \cdot 25°$ K. (critical temperature). An important result is that $a_{1,\infty} = 1 \cdot 00$ remains valid when the glass surfaces covers itself with a monomolecular layer of the gas in question. [For Part II see Abstract 276 (1937).] AUTHORS.

**5019. Conduction, Convection and Associated Heat-Mass Transfer. E. Schmidt.** *Die Physik*, 5. 4. *pp.* 101–117, 1937.—An outline of the contributions made to the above branches of heat since the previous publication [see Abstract 4965 (1933)]. R. W. P.

## CONVECTION.

**5020. Heat Loss by Natural Convection from Vertical Cylinders. J. B. Carne.** *Phil. Mag.*, 24. *pp.* 634–653, *Oct.*, 1937.—The heat loss by natural convection from vertical cylinders of dia. from 0·5 to 7·6 cm. and heights from 7·6 to 330 cm. has been determined for temperature excesses of approximately 80° C. by the steam condensation method. The radiation correction was kept below 8% of the total heat loss, and other corrections were determined experimentally. A formula satisfying the results for the heat loss coefficient of $\theta^{5/4}$ for cylinders of greater height than 30 cm. is found to be $\alpha \times 10^6 = 15 \cdot 24\mathrm{L}^{0 \cdot 212} + 42 \cdot 7/d$, where $\alpha\theta^{5/4}$ is the heat loss per unit area per ° C., difference of temperature for a cylinder of dia. $d$ cm., and of length L cm. in cal./sec. The variation of $\alpha$ with $d$ is in general agreement with that found by previous workers, but the dependence of $\alpha$ on L for planes, obtained by extrapolation, is in marked disagreement with previous determinations. In an Appendix the determination of the loss by evaporation from water drops is described. AUTHOR.

**5021. Convective Cooling of Wires. W. Elenbaas.** *Physica*, 4. *pp.* 761–765, *Oct.*, 1937. *In German.*—The theory of the energy loss by heat conduction for filaments of different diameters in a gas, given by Langmuir, is combined with the hydrodynamical theory.

*See also* Abstract 5019.

## MELTING AND BOILING POINTS.

**5022. Crystal Formation above the Melting Point. R. Kaischew.** *Ann. d. Physik*, 30. 2. *pp.* 184–192, *Sept.*, 1937.—The possibility of the formation of small crystals in melted bodies above the melting point in consequence of oscillation phenomena is investigated theoretically. The distribution of equilibrium of the small crystals is deduced kinetically by means of a simplified crystal model. In connection therewith some consequences are drawn which are in agreement with experiment. J. J. S.

**5023. Liquefaction of Gases by the Desorption Method. F. Simon.** *Physica*, 4. *pp.* 879–899, *Oct.*, 1937. *In English.*—After general consideration a comparison is made between desorption stages (D-stages) and those working with a liquid or solid (C-stages). The experimental results in the He and $H_2$ region are discussed and it is found that D-stages cover at least the same temperature range that a C-stage would, if a suitable substance existed for the temperature range in question. A detailed examination is made of the specific properties of a D-stage, improvements are suggested, and, finally, a survey is made of the principal fields of application of the desorption method. [See also Abstract 3099 (1935).] AUTHOR.

**5024. Evaporation of Water-Drops. T. Namekawa and T. Takahashi.** *Kyoto Coll. Sci., Mem.* 20. *pp.* 139–146, *July*, 1937. *In English.*—A short theoretical and experimental study of the evaporation of a small water drop with a radius under 1 mm. The decrease of the radius of such a drop due to evaporation can be expressed as $dR/dt = -(D\beta/Rk)(p_0 - p_0)$, where $R$ = radius of drops, $D$ = molecular diffusion constant of water vapour into air, $k = P/\sigma\rho$; $P$ = barometric pressure, $\sigma = 0{\cdot}623$, $\rho$ = density of air, $p_1$ = saturation pressure for temperature of drop, $p_0$ = vapour pressure of surrounding air, $\beta$ = a constant depending on $v$, relative velocity of drop in the air. AUTHORS.

***5025. Packing of Fractionating Columns. D. F. Stedman.** *Canad. J. of Research*, 15. *Sect. B. pp.* 383–400, *Sept.*, 1937.—The factors limiting the utility of packings for fractionating columns are considered in detail. In view of these factors a type of packing is described which gives an effectiveness up to 20 plates per foot of height, and has a capacity at least equal to similar equipment of lower efficiency. These packings are constructed of fine mesh wire gauze, and special constructions are described for laboratory use and also for high-capacity apparatus. The method of calibration is given and factors are evaluated for comparison of packing for batch and for continuous stills. AUTHOR.

*See also* Abstracts 4961, 5017, 5019, 5020, 5035.

## TEMPERATURE, MEASUREMENT OF.

***5026. Relay-Free Triode Control for Thermostat. H. S. Schwenk and D. E. Noble.** *J. Phys. Chem.* 41. *pp.* 809–810, *June*, 1937.—A gas-filled triode is used in controlling temperature without the employment of a relay and the current through the thermo-regulator points is reduced to 2 mA. While the triode is not conducting, the current to the heating coil is supplied through a lamp, and when the thermo-regulator brings the valve into play the heating coil receives current also through the plate circuit of the valve. A water bath of about 50 l. can be kept to ± 0·005° C. at 25° C. H. M. B.

***5027. Constant Temperature and Humidity Chamber. E. Seddon.** *Soc. Glass Technol., J.* 21. *pp.* 350–355, *Aug.*, 1937.—Constructional details are given for chambers designed to give accurate control of temperature and humidity, in investigations on certain properties of glasses, such as chemical durability and electrical resistivity. AUTHOR.

***5028. Electric Thermostat Design and Mains-Operated Isothermal Chamber. L. B. Turner.** *I.E.E., J.* 81. *pp.* 399–417; *Disc.*, 418–422, *Sept.*, 1937.—The author gives a review of the general principles of the design of equipment for maintaining a chamber at constant temperature, discussing particularly those in which the temperature-sensitive element forms part of a bridge network and also the problem of hunting. It is concluded that hunting does not depend on the heat capacity of the chamber, that the inconstancy of temperature does not depend on the thoroughness of the heat insulation and that, of the two chief causes of inconstancy, changes of supply voltage are more important than changes of ambient temperature. A description of an equipment designed by the author for maintaining a quartz crystal at 50° C. to within ± 0·001° C. is given. The author sees no obstacle in applying the same principles to much larger chambers. E. O. T.

*See also* Abstract 5070.

## THERMOCHEMISTRY.

**5029. Heats of Solution in $H_2O$ and $D_2O$. E. Lange and W. Martin.** *Zeits. f. phys. Chem.* 180. *Abt. A.* 3. *pp.* 233–245, 1937.—The isotopic effects (= differences) of heats of solution of salts in $H_2O$ and $D_2O = L_0^{D_2O} - L_0^{H_2O} \approx L_m^{D_2O} - L_m^{H_2O}$, earlier described [see Abstract 4785 (1936)] have now been partly redetermined and other salts investigated, while in addition measurements of the undissociated $Hg(CN)_2$ have been made in which only van der Waals forces are operative. The heat of hydration of $Hg(CN)_2$ has been computed from the data on the heats of sublimation and solution. Based on theoretical considerations, certain defects in the data for heats of hydration have been computed and the process extended to evaluate the isotopic effect of the heats of solution of the alkali halides. Tables of results are included. H. H. Ho.

**5030. Succinic Acid as Secondary Calibration Substance for Combustion Bombs. W. A. Roth and G. Becker.** *Zeits. f. phys. Chem.* 179. *Abt. A.* 6. *pp.* 450–456, 1937.—Experimental investigations indicate that pure succinic acid is a convenient and reliable secondary calibration substance for combustion bombs. The heat of combustion is 3025·7 cal. (15°) per gm. (reduced to a vacuum) for isothermal combustion at 20° C. and at constant volume. L. A. W.

**5031. Critical Recalculation of Heats of Reaction. W. A. Roth and A. Bertram.** *Zeits. f. phys. Chem.* 179. *Abt. A.* 6. *pp.* 445–449, 1937.—The heats of formation of AgCl, AgBr and AgI recently determined by the authors [see Abstract 1287 (1937)] are utilised for the calculation of some heats of reaction. The heat of formation of HCl is discussed in detail and the value + 21·89 k.cal., which was previously regarded as the most probable, is confirmed by a new calculation. L. A. W.

**5032. Luminous Phenomena Accompanying a Shock Wave in Different Gases. H. Muraour, A. Michel-Lévy and E. Burlot.** *J. de Physique et le Radium*, 8. *pp.* 330-331, *Aug.*, 1937.—An investigation of the luminosity produced in different gases by the shock wave originating from the explosion of a cartridge at the end of a cylinder of cellophane containing the gas has been carried out, using a rotating drum camera to record the phenomena. The results show that the luminosity is more intense in gases of greater atomic or molecular weight, and in gases of lower specific heat. It is claimed that the results agree with the theory that the flash of an explosion is due not to the gas emitted by the explosive but to the increase of the temperature in the surrounding medium due to the passage of the shock wave. [See also Abstract 1738 (1937).] G. O. B.

**5033. Mechanism of Flame Movement. H. F. Coward, F. J. Hartwell, and E. H. M. Georgeson.** *Chem. Soc., J. pp.* 1482–1489, *Sept.*, 1937.—The vibratory movement during the propagation of flame in various mixtures of $CH_4$ and air contained in tubes of various dimensions, the flame travelling from an open towards a closed end, has been examined. Each of the frequencies observed in tubes up to 10 m. in length corresponded with the fundamental note or with a low overtone of the whole column of gas in the tube, as calculated from Lees' formula. In a tube 32·3 m. in length the vibrations were less regular but many of them corresponded with the fundamental note. Various means were discovered for suppressing the vibrations of such a flame, including a partial closure of the open end of the tube and a provision of gauze releases along the wall of the tube. In a certain tube of square cross-section the flame failed to vibrate, whereas in a tube of equal length and equal (but circular) cross-sectional area the vibrations were large in amplitude. AUTHORS.

**5034. Temperature Dependence of Flame Velocity and Temperature Gradient in the Flame Front. H. Sachsse.** *Zeits. f. phys. Chem.* 180. *Abt.A.* 4. *pp.* 305–313, 1937.—The flame velocities of methane, ethane and propane admixed with $O_2$ have been determined with respect to $O_2$-content and temperature of preheating by measurement of the cone heights in the Bunsen flame. It is found that the flame velocity rises only slowly with the temperature, and that in the case of the $CH_4$-$O_2$ mixtures it amounts at 1000° C. to only three times the value at room-temperature. From these measurements, combined with earlier observations on the induction-period of the flash point, it follows that the chemical reaction velocity of the combustion process has no appreciable influence on the velocity of flame propagation and on the temperature gradient in the flame front. H. H. Ho.

## THERMODYNAMICS.

**5035. Boiling Point and Critical Constants of Normal Heptane. J. A. Beattie and W. C. Kay.** *Am. Chem. Soc., J.* 59. *pp.* 1586–1587, *Sept.*, 1937.—The boiling point of normal heptane is 98·52 ± 0·01° (Int.) at 760·0 mm. pressure. The critical constants of normal heptane ($C_7H_{16}$, mol. wt. 100·1248) are $t_c = 267{\cdot}01 \pm 0{\cdot}02°$ (Int.), $p_c = 27{\cdot}00 \pm 0{\cdot}02$ normal atmosphere, $v_c = 0{\cdot}416$ l./mol. (4·15 cc./gm.), $d_c = 2{\cdot}40$ mol./l. (0·241 gm./cc.). The uncertainty in the critical volume and density is 1%. AUTHORS.

**5036. Equation of State for Normal Heptane. L. B. Smith, J. A. Beattie and W. C. Kay.** *Am. Chem. Soc., J.* 59. *pp.* 1587–1589, *Sept.*, 1937.—Measurements are reported on the compressibility of liquid normal heptane over the temperature range from 30° to 250° and to 350 atmos., and on the compressibility of the gas phase from 275° to 350° and from a density of 1·0 to 5·0 mol./l. The constants of an equation of state for the gas phase are determined from the data for densities less than the critical. AUTHORS.

**5037. Equation of State for Gaseous Propane. J. A. Beattie, W. C. Kay and J. Kaminsky.** *Am. Chem. Soc., J.* 59. *pp.* 1589–1590, *Sept.*, 1937.—Measurements are reported on the compressibility of gaseous propane over the temperature range 96·81° to 275° and from a density of 1·0 to 10·0 mol./l. The values of the constants of an equation of state are determined from the data for densities less than the critical. AUTHORS.

**5038. Specific Heats of Solids Due to Molecular Rotations. T. S. Chang.** *Cambridge Phil. Soc., Proc.* 33. *pp.* 524–533, *Oct.*, 1937.—Bethe's method [see Abstract 3259 (1935)], used in the problem of order-disorder transitions in alloys, is applied formally to the problem of molecular rotations in solids. To apply this method it is assumed that the solid is entirely homogeneous, and that the state of rotation is the same throughout the solid. Without this assumption, the application of this method is impossible. A particular form of the mutual potential energy between two neighbouring molecules has been chosen, and classical statistics is employed throughout. The calculations are made entirely after the manner of Bethe, and the similarities of the two problems are pointed out. The result is that there is a critical temperature, and also a discontinuity in the specific heat of the magnitude of some ten times the Boltzmann constant per molecule, arising from the sudden setting in of the rotations as the temperature is increased beyond the critical point. Agreement with the experiments is bad, indicating that a more profound theory is necessary. AUTHOR.

**5039. Entropy and Heat Capacity of Methylamine. J. G. Aston, C. W. Siller and G. H. Messerly.** *Am. Chem. Soc., J.* 59. *pp.* 1743–1751, *Sept.*, 1937.—The heat capacity of methylamine has been determined from 11·5° K. to the boiling point. In the range 95° to 175° K. the heat capacity of the solid exhibits hysteresis effects. The melting point is 179·70° (− 93·46° C.) and the boiling point is 266·84° K. (− 6·32° C.). The heats of fusion and vaporisation are 1465·8 and 6169 cal./mol., respectively. The vapour pressure of the liquid has been determined over the range 190° K. to the boiling point, and the equation is given. The "spectroscopic" entropy calculated from the Raman spectrum and moments of inertia, is 58·06 e.u./mol. at 1 atmos. and 266·84° K. The molal entropy of the ideal gas at the boiling point, calculated from the experimental data, is 56·42 ± 0·3 E.u. This value is 1·6 E.u. less than the corresponding "spectroscopic" value. The molal entropies of the superheated liquid and ideal gas at 298·16° K. and 1 atmos. are 35·90 and 57·73 E.u. respectively. AUTHORS.

**5040. Thermodynamic Properties of *n*-Butane. B. H. Sage, D. C. Webster, and W. N. Lacey.** *Indust. and Engin. Chem.* 29. *pp.* 1188–1194, *Oct.*, 1937.—Specific volumes and latent heats of vaporisation of *n*-butane were experimentally determined at temperatures from 70° to 250° F. From these and other published data the changes in enthalpy, entropy, and fugacity with temperature and pressure were calculated. The results of this work are presented in tabular and graphical form. AUTHORS.

**5041. Application of Virial Theorem to Approximate Molecular and Metallic Eigenfunctions. J. O. Hirschfelder and J. F. Kincaid.** *Phys. Rev.* 52. *pp.* 658–661, *Sept.* 15, 1937.—Fock's treatment [see Abstract 50 (1931)], whereby the virial theorem is automatically satisfied for any quantum-mechanical system whose potential is a homogeneous function of the coordinates, is extended to problems involving molecules or metals. This modification, in which a scale factor is inserted in the approximate charge distribution and varied so as to give the lowest energy, necessitates little additional work and leads to considerable improvement in the derived physical properties. This is shown to be true when the scale factor is inserted in the Heitler-London-Sugiura eigenfunction for $H_2$ and varied to form the Wang function. Again, the James and Coolidge function for $H_2$ does already almost satisfy the virial theorem, but can be made to do so exactly by the introduction of the scale factor 1·0029. R. W. P.

**5042. Expressions for First Partial Derivatives of Thermodynamic Functions. F. Lerman.** *J. Chem. Phys.* 5. *pp.* 792–794, *Oct.*, 1937.—By this direct method, any first partial derivative of the thermodynamic functions may be readily resolved into terms of temperature, pressure, volume, and entropy, and of six basic forms of a mathematical quantity named a vired. These six basic vireds have been expressed in terms of the better known and more easily measurable thermodynamic quantities and, therefore, may be used in determining any of the first partial derivatives. This method stresses the interrelationship between the partial derivatives and is a distinct departure from Bridgman's method for obtaining expressions for the first derivatives by substitution from a list of 45 arbitrarily defined quantities which have been expressed in simpler terms. AUTHOR.

*See also* Abstracts 4784, 4798, 4868.

## VAPOUR PRESSURE.

**5043. Partial Pressures of Hydrogen Chloride from Benzene Solutions at 30°. J. H. Saylor.** *Am. Chem. Soc., J.* 59. *pp.* 1712–1714, *Sept.*, 1937.—The partial pressures of HCl from benzene solutions have been determined directly and the results indicate that it is a normal solute in dry benzene and in benzene simultaneously saturated with water. AUTHOR.

***5044. Equilibria in Two-Phase, Gas-Liquid Hydrocarbon Systems. Part I. E. H. Boomer, C. A. Johnson and G. H. Argue.** *Canad. J. of Research*, 15. *Sect. B. pp.* 367–374, *Sept.*, 1937.—An apparatus is devised by means of which a gas and a liquid can be brought into equilibrium at any desired pressure up to 370 atmos. and temperatures from 25° to above 100° C. Provision is made for the taking of samples of known volume from the liquid and gas phases in equilibrium. Analytical methods are developed to yield phase densities and compositions. AUTHORS.

# ACOUSTICS.

**5045. Acoustic Radiation Pressure and Waves of Large Amplitude. E. F. Ghiron.** *Alta Frequenza*, 6. *pp.* 640–653, *Oct.*, 1937. *English Abstract.*—Phenomena of acoustic radiation are closely connected with anomalous propagation of waves of large amplitude. In the case of plane waves it is found that a fluid carrying a progressive wave is subjected to a variable pressure, the mean value of which differs from the pressure when at rest. If a wall closes the tube in which the fluid moves, it is subject to forces depending upon its orientation, and they are not perpendicular to the surface. The general result may be expressed by a tensor, the terms of which are calculated. Absorbent walls only can be rigorously dealt with. Results concerning reflecting walls are approximate. [See also Abstract 1282 (1936).] AUTHOR.

**5046. Sound Propagation in Ducts Lined with Absorbing Materials. L. J. Sivian.** *Acoustical Soc. of America, J.* 9. *pp.* 135–140, *Oct.,* 1937.—In ventilator and exhaust systems it is desirable to provide a high degree of attenuation for audio-frequency waves while offering low resistance to continuous or slowly pulsating air flow. For that purpose ducts lined with absorbing materials are sometimes used. This paper deals with sound propagation, particularly with its attenuation constant, in such ducts. Two types of lining are considered: (*a*) non-vibratile, *i.e.*, a lining in which there is no wave motion propagated in the direction of the duct axis; (*b*) vibratile, *i.e.*, a lining admitting of such motion. Methods for computing the propagation constants in terms of the acoustic constants of the lining, are given. Some experimental data are presented. Comparison of observed and computed values indicates that the computational procedure is substantially valid up to a frequency at which the sound wave-length is about twice the internal duct diameter. AUTHOR.

**5047. Sound Waves in a Moving Medium. J. D. Trimmer.** *Acoustical Soc. of America, J.* 9. *pp.* 162–164, *Oct.,* 1937.—A theoretical approach is made to the problem of the behaviour of sound waves in a pipe through which the medium is moving in a unidirectional flow with uniform velocity V. Calculation indicates the resonances of pipes to be affected by the steady flow so that the resonance peaks are flattened, while the separation between nodal points is reduced by the factor $1 - (V/c)^2$. AUTHOR.

**5048. Interference Phenomenon with Supersonic Waves. E. Schreuer and K. Osterhammel.** *Zeits. f. Physik*, 107. 1–2. *pp.* 44–47, 1937.—The method of Hiedemann and Hoesch (see Abstract 1306 (1937)] was employed to obtain photographs of interference phenomena with supersonic waves. If a semi-transparent reflector plate is introduced into a system of stationary supersonic waves, the plate being inclined to the wave-fronts, a sharp system of interference bands can be observed perpendicular to the plate, the band width and distance apart depending, other conditions being the same, on the orientation of the plate. Interference bands can also be obtained with two wave systems having their directions of propagation inclined at some convenient angle. Beautiful photographs of such bands are obtained by stroboscopic illumination, using a Kerr cell, when the combination wave itself becomes visible. The photographs reproduced were obtained with frequencies of about 3000 kc./sec., the liquid used being xylol. A. W.

**5049. Differential Pitch Sensitivity of the Ear. W. E. Kock.** *Accoustical Soc. of America,* J. 9. *pp.* 129-134, *Oct.,* 1937. A critical examination is made of experiments which have aimed at determining the differential pitch sensitivity of the ear, *e.g.,* those of Knudsen [see Abstract 2230 (1923)] and Shower and Biddulph, [see Abstract 1303 (1932)]. It is noted that in Shower and Biddulph's experiments, the test frequency glided between the two tones which were to be distinguished by the observer and that, in fact, a type of warble note was used. By a mathematical analysis of a warble note it is shown that as the extent of the warble increases so the spectrum of the note splits up into two groups and two separate notes would be heard. On this basis it is possible to calculate the variation of differential pitch sensitivity with main frequency for an ideal ear having infinite discrimination. It is shown that the relation calculated agrees almost exactly with the experimental observations and that, in other words, the observation did not determine the differential pitch sensitivity of the ear. Other measurements made to determine the relation between differential pitch sensitivity and sensation level are dealt with in a similar manner. It is noted, however, that the experimental observations on the connection between differential pitch sensitivity and modulation frequency do differ from what would have been expected for a perfect receiver. To account for the observation, a mathematical analysis is made of the response of a series of resonators to a note containing two components. A curve more nearly agreeing with the observation is thus obtained. J. E. R. C.

**5050. Beginning of a Vowel Sound and Shock of the Glottis. W. Trendelenburg.** *Preuss. Akad. Wiss. Berlin, Ber.* 13. *pp.* 127–143, 1937.—In the present paper accentuated spoken vowels are investigated, and further support is obtained for the view that the starting group of vibrations coincides with the opening of the glottis [see Abstract 2746 (1937)]. Simultaneous records were made of the vowel vibrations in air, and the vibrations of structures below the larynx such as the wall of the trachea and the breast bone. If, before the opening of the glottis, the compressed air below sets up vibrations, then the first part of the curve for different vowels must have the same form for structures below the larynx. With sharply sounded vowels the curves show a slight difference at the beginning of the air vibrations in the trachea for different vowels. This contradicts the usual explanation of the shock of the glottis. Simultaneous records were also made of the air vibrations in front of the mouth and the vibrations of the wall over the trachea. Allowing for the time taken between glottis and microphone, there is no measurable difference between the commencements of the vibrations above and below the vocal cords. This disproves the assumption that, in the shock of the glottis, a pressure vibration of the air below the vocal cords precedes the opening of the glottis. G. E. A.

**5051. Optimum Frequency for Sound-Signals. W. Janovsky and A. Rechten.** *Wiss. Veröff. a. d. Siemens-Werken,* 16. 2. *pp.* 84–91, 1937.—Aigner has considered the influence of ear-sensitivity and atmospheric absorption upon the effectiveness of a sound signal and has deduced on this basis curves relating the most suitable frequency with the distance at which the sound is to be heard. The present paper expands this work and takes account of the fact that for given dimensions of the sound source, higher frequencies are better focused. Curves which allow for this fact are given and are compared with the experimental results of U. John and T. Pederzani, good agreement being found. For audibility at considerable distances the general result appears to be that a low note is necessary, but that at moderate distances (of the order of 1 km.) a note of about 1000 ∼ is best. J. E. R. C.

***5052. Direct-Reading Pitch Recorder and its Applications to Music and Speech. J. Obata and R. Kobayashi.** *Imp. Acad. Tokyo, Proc.* 13. *pp.* 247–250, *July*, 1937. *In English. Acoustical Soc. of America, J.* 9. *pp.* 156–161, *Oct.*, 1937.—The recorder apparatus contains an amplifier, wave-form adjuster, automatic volume control, second amplifier, frequency meter, smoother, final amplifier and oscillograph. The microphone is connected to the input terminals of the first amplifier, or, if a gramophone record is used, the pick-up is connected to the second valve of the first amplifier. The frequency meter consists of two argon-filled thyratrons connected in push-pull. The wave-form adjuster strengthens the fundamental and suppresses intense overtones. The pitch changes have been recorded for a flute solo, a soprano solo and speech. The arrangement may also be used for determining the number of revolutions of a rotating machine by means of the emitted sound. G. E. A.

***5053. Tone Source. K. O. Lehmann.** *Zeits. f. techn. Physik*, 18. 10. *pp.* 304–308, 1937.—The author has constructed a vibrating reed oscillator, using a moving-coil feed-back system for stabilising its amplitude of oscillation. Its peculiarity is that the reed consists of a tube attached to a spring, and the effective mass, and, therefore, the frequency of oscillation, is determined by the height of mercury forced into the tube by a plunger system; registration of the amount of mercury in motion is made by compressing air in a calibrated tube. The generator is constructed for the frequency range 65–147 ∼, the wave-form being very pure. L. E. C. H.

**5054. Acoustical Experiments with Telephone Receivers. Parts I and II. E. Tyler.** *Phil. Mag.* 24. *pp.* 665–686, *Oct.*, and *pp.* 905-939, *Nov.*, 1937. *Supplement.*—Descriptions of various non-aural electrical methods for the measurement of the velocity of sound in air contained in various pipe systems and free air are given. An electrically-maintained telephone earpiece, energised by either a valve oscillator or oscillating neon tube is employed as the source of sound, and its frequency determined stroboscopically by the standardised a.c. mains supply of 50 ∼. Computation of the wave-length of the sound vibrations is effected by either measuring the variable reactive effects at the source, or employing a second telephone earpiece and a 2-valve amplifier as a detector of the aerial vibrations. In each case the effects are recorded electrically and examined in terms of the resulting rectified currents. Graphical representation of such results permitted interpolation of the wave-length and final deduction of the speed of sound in air. A further adaptation of the pipe results is mentioned whereby the natural frequency of vibration of a clamped telephone diaphragm may be ascertained. A critical review of the various techniques usually employed in the examination of aerial vibrations within pipes is also included. AUTHOR.

*See also* Abstracts 4836, 5033.

# ELECTRICITY AND MAGNETISM.

## ALTERNATING-CURRENT NETWORKS.

**5055. Compensation Method for Measuring Small Inductances Associated with High Resistances. J. Listray.** *Assoc. Ing. Él. Liège, Bull.* 17. *pp.* 185–195, *July*, 1937.—A method is described for the measurement of small inductances incorporated with high resistances, such as the pressure coils of wattmeters and moving-iron voltmeters, where the resistance considerably exceeds the inductive reactance, especially for high ranges. A form of a.c. bridge is used with a vibration galvanometer as detector; the theory is given, together with results of tests which show the superiority of the method compared with existing methods. E. H. W. B.

*5056. **Self-Balancing A.C. Bridges. W. Geyger.** *Zeits. f. techn. Physik*, 18. 9. *pp.* 259–270, 1937.—The current coils of instruments of the wattmeter type, *e.g.*, induction meters, are fed from the detector circuit of the a.c. bridge, either directly or through amplifiers. The pressure coils are supplied with voltages in phase and in quadrature, respectively, with the voltage applied to the bridge. The rotor of the wattmeter instrument operates the balancing elements of the bridge through gearing. Balance is attained in less than a second, and the heavy damping of the wattmeter instrument prevents overshooting. P. V.

*See also* Abstracts 4906, 5080.

## CONDUCTION AND DISCHARGE IN GASES.

**5057. Influence of Breakdown Voltage on the Distribution of the Paths of an Electric Spark. K. Kitagawa.** *Phys. Math. Soc., Japan, Proc.* 19. *pp.* 839–846, *Sept.*, 1937. *In French.*—The distribution of the paths of a discharge in air between a needle and a copper plate has been studied. The path of the spark varies considerably, depending on the distribution of free ions, etc. Electricity passes more easily from the needle to the plate than from the plate to the needle. It was suggested that the scale type of distribution depended on the distance from the needle to the plate. The present work shows that the increase of voltage has no important effect on the distribution. C. J. B. C.

**5058. A.C. Measurement of Ionisation in Gases. H. W. Paehr.** *Zeits. f. Physik*, 106. 11–12. *pp.* 730–750, 1937.—The a.c. current passed by a condenser containing ionised gas between its electrodes was determined for different applied a.c. voltages. The current exhibits a maximum at a voltage of the order of one-fourth that necessary to sweep all the ions present to the electrode in one-half cycle (a.c. saturation voltage). At its maximum the current far exceeds the maximum current obtainable with a d.c. voltage. The explanation of this fact is that the positive and negative ions in the gas form two distributions of space-charge which oscillate under the action of the applied voltage and give rise to a type of displacement current. The theory of this displacement current is worked out and is found to give results in good accord with the experiments. In the latter, a steady source of ions was obtained from a $\gamma$-ray source, and for the measurements the condenser (ionisation chamber) formed one arm of an a.c. bridge. W. S. S.

**5059. Examination of an Electron Surge with the Cloud Chamber. H. Raether.** *Zeits. f. Physik,* 107. 1–2. *pp.* 91–110, 1937.—The electron surge produced when an electric field causes cumulative ionisation by collision is examined with an expansion chamber. With air at a pressure of 270 tor and an electric field of 9 kV/cm. the forward velocity of the surge is estimated from the length of the track and the time of application of the field and is found to be 1·25 × $10^7$ cm./sec.; similar experiments with $H_2$ gave 0·75 ± $10^7$ cm./sec. Comparison with the velocity formula gives the thermal energy of the electrons. For air the result agrees with the value obtained by measuring the breadth of the track and applying data on thermal diffusion. With $H_2$ the agreement is less good and the discrepancy is explained as being due to doubtful values of the mean free path of the electron. The experiments were extended to cover a wide range of pressures. F. C. C.

**5060. Discharge of a Condenser across a Tube of Gas. M. Laporte.** *J. de Physique et le Radium,* 8. *pp.* 332–342, *Aug.,* 1937.—Arising from some earlier work [see Abstract 908 (1937)] the author first makes a theoretical investigation of the classical problem of the growth and decay of a current in a circuit containing inductance, capacity and resistance. The variations are studied, as a function of one or other of the variables R, L or C, of the maximum current intensity I, the time *s* for the growth of the current to its maximum value, and in general the intensity of the current as a function of time. A considerable simplification is obtained by the use of reduced variables, obtained by taking as units the magnitudes $R_1$, $L_1$, $C_1$, $I_c$, and $s_c$, which are the values of the respective variables in the case of a critically damped decay. An experimental study is made of the case in which the discharge circuit of the condenser contains a tube filled with gas at a moderately low pressure (approximately 5 mm.). Analogies with the preceding case are indicated. It is established that as far as the maximum intensity of the current on discharge is concerned, the results show that the tube appears to present a constant resistance. A method of determining this resistance is given. Finally, a method is indicated by which the coefficient of inductance of such a circuit containing a gas-discharge tube can be obtained. G. O. B.

**5061. Propagation of Potential in Discharge Tubes. L. B. Snoddy, J. R. Dietrich and J. W. Beams.** *Phys. Rev.* 52. *pp.* 739–746, *Oct.* 1, 1937.—Measurements were made of the speed of propagation of potential waves in long discharge tubes containing dry air, using positive and negative impulse potentials of about 125 kV. In general, in the low pressure range, the speed increases with increasing pressure. At relatively high pressures the speed decreases and the wave-shape is greatly distorted. At constant pressure the speed is approximately a linear function of the applied voltage. The speed is found to obey the principle of similarity, the speed in a tube of 18 mm. dia. being the same as that in a tube of 5 mm. dia. when the pressure in the latter is 3·6 times that in the former. The initial wave traversing the tube from the h.v. end to the grounded end is followed immediately by a return wave whose speed is about $10^{10}$ cm./sec. and is apparently independent of the tube diameter. A. W.

**5062. Ionising Action of Kathode Rays in Gases. W. Gerbes.** *Ann. d. Physik,* 30. 2. *pp.* 169–183, *Sept.,* 1937.—The ionising action of kathode rays in gases was investigated and the mean energy loss per pair of ions, $\epsilon$, measured, and also from the dependence of this magnitude on the velocity of the kathode rays the differential energy loss per pair of ions, $\gamma$, was determined. The measurements were carried out relatively to air. The gases $N_2$, $O_2$, $CO_2$, $C_3H_8$, $SO_2$, A, and Ne were examined in a range of velocity of the kathode rays from 10 to 40 kV. Similar measurements were made at 20 kV for $C_3H_8$-$N_2$ mixtures of various composition. For the same gases at an electron velocity of 20 kV the differential ionisation (number of ions per cm. length of path $s$) was determined. It was found that $s$ is not as is generally assumed simply proportional to the electron density Z of the gas, but proportional to $1/\gamma Z$. Thence it follows that the energy loss per cm. length of path $dV/dx$ is proportional to Z. For gas mixtures $s$ (not $\epsilon$) is given as additive from the composition of the mixture. Thus for $\epsilon$ a mixture formula is deduced. J. J. S.

**5063. Dissociation by Electron Impact. P. Kusch, A. Hustrulid and J. T. Tate.** *Phys. Rev.* 52. *pp.* 840–854, *Oct.* 15, 1937.—The products of dissociation of $SbCl_3$, $AsCl_3$ and $PCl_3$ by electron impact have been investigated. Ions of the types $XCl_3^+$, $XCl_2^+$, $XCl^+$ $X^+$, $XCl_2^{++}$, $XCl^{++}$, and $Cl^+$ have been observed. The efficiencies of production of these ions for various electron energies have been investigated. The appearance potentials have been determined and a partial analysis of the results have been made. The dissociation of HCN and $C_2H_4$ by electron impact has been investigated. An analysis of the results for these two molecules, together with an analysis of previously published results on the dissociation processes occurring in $C_2H_2$ and $C_2N_2$, is presented. It is possible to assign reasonable processes of formation to all the observed ions from a knowledge of their appearance potentials, the known ionisation potentials of certain atoms and atomic aggregates and the energies of dissociation of the parent molecule into various configurations. By a comparison of the results obtained for these four molecules, upper limits are assigned to the ionisation potentials of various fragments obtained as dissociation products of hydrocarbons. AUTHORS.

**5064. Nuclear Excitation and Disintegration Collisions Involving Strong Interaction. Part I. H. S. W. Massey and C. B. O. Mohr.** *Roy. Soc., Proc.* 162*A*. *pp.* 529–556, *Oct.* 15, 1937.—The quantum theory of collisions must be worked out to a higher degree of accuracy than hitherto if it is to be capable of describing the resonance phenomena which are a striking feature of collisions between nuclei. In particular it is essential that the assumption of predominance of elastic scattering be not involved. In this paper calculations have been carried out for excitation and capture phenomena without this assumption. The complication is so great that the work in this paper is confined to cases which are of a two-body nature (or three-body if the nuclear core is included), but the results provide qualitative and, in some cases, some quantitative information concerning the resonance effects to be expected. They also show that the resonance phenomena must be related to energy levels of the semi-stable complex formed in the intermediate stage of the collision and cannot be understood in terms of energy levels of a single particle moving in a static potential field. AUTHORS.

**5065. Determination of Townsend's Ionisation Coefficient. S. Moralew.** *Phys. Zeits. d. Sowjetunion,* 12. 1. *pp.* 89–104, 1937. *In German.*—A method is given for calculating Townsend's coefficient of volume ionisation $\alpha$, in which the individual elementary processes (elastic and inelastic losses and impacts of the second kind) are taken account of, both for pure gases and mixtures. It is found that the ionisation coefficient $\alpha$ is a function of the field-strength, the pressure and the energy loss of the electrons, *i.e.*, $\alpha = \phi\,(E/p,\ K)$, where K represents the elastic and inelastic losses. The value of $\alpha$ decreases for certain concentrations in mixtures on account of the increased inelastic losses. The effect of small admixtures ($N_2$ in A) has no appreciable effect on the value of $\alpha$. In the case of mixtures in which ionisation by impacts of the second kind occurs, the value of $\alpha$ passes through a maximum for a certain concentration (A in Hg vapour) and then decreases for higher concentrations. The ionisation coefficient for a mixture of A and Hg vapour decreases appreciably when only small quantities of a molecular gas ($N_2$) are added. A. W.

**5066. Doppler Effect in Canal Rays. B. Venkatesachar.** *Current Science*, 6. *pp*. 51–52, *Aug*., 1937.—Summarises the present position in this subject. A. H.

**5067. Secondary Kathode Rays from Insulators. G. Katz.** *Zeits. f. Physik*, 107. 1–2. *pp*. 48–50, 1937.—Investigation shows that the phenomenon of secondary kathode rays from insulators such as glass, observed by Wehnelt, is not limited to one particular range of velocities of the primary kathode rays. The assumption that the potential built up on the insulator, to which the production of the secondary rays is ascribed, is constant, appears to be erroneous. A. W.

***5068. Behaviour of an Osglim Lamp. L. F. Richardson.** *Roy. Soc., Proc.* 162*A*. *pp*. 293–335, *Oct*. 1, 1937.—Describes the results of experiments performed on an osglim lamp, from which a single law is obtained applying to all the varieties of behaviour which occur during various periodic disturbances of voltage across the osglim and current through it. Detailed examination is made of drift, equilibrium and a.c. bridge measurements of small oscillations, and oscillograph methods, steady motion and relaxational oscillations with reference to relatively large oscillations, it being shown that the law deduced for small oscillations holds for oscillations which are very unsymmetrical and not small. Finally, physiological and psychological analogues are suggested, although it is found that the relaxational oscillation wave-form differs considerably from that first analysed by van de Pol. R. C. F.

*See also* Abstracts 4915, 4916, 4917, 4918, 4919, 4935, 4970, 5010, 5090, 5091, 5092, 5130.

## CONDUCTION IN SOLIDS AND LIQUIDS.

**5069. Conductivity of Monovalent Metals. J. Bardeen.** *Phys. Rev.* 52. *pp*. 688–697, *Oct*. 1, 1937.—The electrical conductivity of monovalent metals is calculated under the assumption that the wave functions of the electrons are nearly the same as those of free electrons throughout the major part of the volume. The treatment is new in that the perturbation resulting from the elastic waves, which is responsible for the transitions between the electronic states, is determined from the change in the self-consistent field of the valence electrons when the crystal is distorted; in addition, account is taken of the probability of transitions resulting from the *Umklappprozesse* of Peierls. To enable comparison with experiment to be made results are tabulated for the ratio $C/\zeta$, C being Bethe's interaction constant and $\zeta$ the Fermi energy. Theoretical and experimental values for Na and K are in fair agreement, but the theoretical values for other monovalent metals are too small. R. W. P.

***5070. Portable Thermocouple Potentiometer. D. R. Barber.** *Journ. Sci. Instruments*, 14. *pp*. 343–346, *Oct*., 1937.—A description is given of the salient constructional features of a portable thermocouple potentiometer employing copper-constantan elements. The instrument indicates temperature values direct from the potentiometer scale over the range 20°–46° C., to within ± 0·1° C. AUTHOR.

**5071. Contact Resistance. J. C. Simmonds.** *El. Times,* 92. *pp.* 427–428, *Sept.* 30, 1937.—Experimental research was carried out to determine the law connecting the resistance of a contact between similar metal surfaces for different contact pressures and currents. No variation of resistance with current was detected; a curve connecting resistance with contact pressure was found to obey the law $R = 0{\cdot}00276P^{-\frac{1}{2}} + 0{\cdot}00162$, from which and from theory the general formula $R = \rho/(K\,P^{-\frac{1}{2}})$ is derived, where $p$ is the resistivity for the materials forming the contacts, K is a constant and P the pressure per unit area. It is further stated that for minimum contact resistance a material should have low resistivity, a small rigidity modulus, and a bulk modulus which is large compared with the rigidity modulus. E. H. W. B.

**5072. Supraconductors in Alternating Magnetic Fields. D. Shoenberg.** *Cambridge Phil. Soc., Proc.* 33. *pp.* 559–576, *Oct.,* 1937.—A method of studying magnetic properties in alternating fields and its application to the intermediate state of a supraconducting sphere are described. It is shown that the behaviour of the sphere in alternating fields of frequencies between 10 and 100 is different from that in very slowly varying fields, the difference becoming less for lower frequencies and for smaller radius. When the specimen is in the intermediate state, energy losses are produced in it by the alternating field, showing that the induced currents are out of phase with the alternating field. The induced currents do not, however, flow in the same way as in a homogeneous isotropic conductor, and this is probably on account of an anistropic structure of the specimen when in the intermediate state. This structure depends strongly on the amplitude of the alternating field in such a way that the effective average conductivity is increased with decreasing amplitude, and this amplitude effect depends on the size of the specimen. Evidence is given for a time-lag in the magnetocaloric effect, and this time-lag decreases with decrease of the size of the specimen, being of order $\frac{1}{10}$ sec. for a sphere of about 1 cm. dia. AUTHOR.

**5073. A.C. Method of Measuring Resistance. D. Shoenberg.** *Cambridge Phil. Soc., Proc.* 33. *pp.* 577–582, *Oct.,* 1937.—Some applications of an alternating field method to various problems of supraconductivity are described. It is shown how the method can be used to measure the resistance and self-inductance of a metal ring, and this was applied to show how the resistance of a supraconducting tin ring is restored by a magnetic field. The method is also convenient for a rapid determination of the order of magnitude of the specific resistance of a substance, and to see whether or not it becomes supraconducting; several elements were examined in this way, but no new supraconductors were found. AUTHORS.

**5074. " Overshoot " Phenomenon in Supraconductivity. A. D. Misener.** *Cambridge Phil. Soc., Proc.* 33. *pp.* 583–585, *Oct.,* 1937.—It is concluded that the " overshoot " phenomenon in supraconductivity described by F. B. Silsbee and others [see Abstract 1787 (1937)] was due to his method of mounting the specimen. AUTHOR.

**5075. Conductivity and pH Values of Calcium Hydroxide Solutions. F. M. Lea and G. E. Bessey.** *Chem. Soc., J. pp.* 1612–1615, *Sept.,* 1937.—Existing data on the conductivity of $Ca(OH)_2$ solutions at 25° show discrepancies. New data are given which confirm certain of the previously published results. Values of pH for Ca(OH)$_2$ solutions at 25° are also given and compared with the only other available data, those of Flint and Wells at 30°. AUTHORS.

*See also* Abstracts 4802, 4809, 5016, 5080.

## DIELECTRICS AND CAPACITANCE.

**5076. Electrical Properties of Solids. Part I. Experimental Methods. R. M. Fuoss.** *Am. Chem. Soc., J.* 59. *pp.* 1703–1707, *Sept.*, 1937.—A method of determining absolute values of dielectric constants of solids is described. Errors due to imperfect contact between sample and electrodes are discussed, and a method of eliminating them is explained. The dielectric constant of fused quartz is 3·810. Pyrex glass at 500 ~ has the following constants : $\epsilon' = 4\cdot810$, $\tan\delta = 0\cdot010$ at 25° and $\epsilon' = 5\cdot185$, $\tan\delta = 0\cdot042$ at 100°. AUTHOR.

**5077. Dielectric Constant of Isopropyl Alcohol Vapour. J. D. Stranathan.** *J. Chem. Phys.* 5. *pp.* 828–830, *Oct.*, 1937.—The dielectric constant of isopropyl alcohol vapour has been measured at 12 different temperatures between 26·8° C. and 190·4° C. At each temperature, measurements were made at many different vapour pressures. It is emphasised that this procedure is highly desirable. The slope, obtained by least squares, of the resulting $(K - 1)/(K + 2)$ *versus* pressure curve gives one point on the Debye line. Twelve such points were obtained. Usually pure isopropyl alcohol was used. The data fall on a Debye line whose equation as obtained by least squares is : $[(K - 1)/(K + 2)]RT/p' = (17\cdot40 \pm 0\cdot41) + (17{,}490 \pm 155)/T$. This yields a value $(1\cdot682 \pm 0\cdot007) \times 10^{-18}$ e.s.u. for the electric moment of the isopropyl alcohol molecule. AUTHOR.

**5078. Electric Moments of Dioxanes and Dioxolanes. M. M. Otto.** *Am. Chem. Soc., J.* 59. *pp.* 1590–1592, *Sept.*, 1937.—Six-membered ring compounds containing two oxygens, dioxanes, have a larger moment than corresponding moments of five-membered rings, dioxolanes. Electric moments are determined for 2-methyl-, 2,4-dimethyl-, 2,4,5-trimethyl-, 2,4,4,5,5-pentamethyl-, 2,2-dimethyl-, and 2-bromomethyl-1,3-dioxolane and for 2-methyl-, 2-methyl-2-amyl-, and 2-bromomethyl-1,3-dioxane. AUTHOR.

**5079. Dielectrics as Insulators. C. F. Hill.** *J. of Applied Physics*, 8. *pp.* 607–613, *Sept.*, 1937.—A brief discussion of recent investigations of the properties of liquid and solid dielectrics, chiefly dealing with the mechanism of dielectric absorption. Maxwell's theory of the imperfect dielectric has now been extended by theories of ions moving against frictional forces and dipole orientation. Curves are given to illustrate resonance effects, supposed to be due to dipoles, in cellulose materials. X-ray studies have yielded similar evidence of the orientation of dipoles in rubber subjected to an electric field. Simple experiments are described to demonstrate the presence of bound electrons in dielectrics and the importance of the ambient medium in dielectric-strength tests. The author suggests that the properties of the interface between the electrodes and the dielectric have a dominating influence on the breakdown voltage. A. M. T.

**5080. Losses in Lecher-Wire Measurements. N. N. Malov.** *Phys. Zeits. d. Sowjetunion*, 12. 1. *pp.* 111–117, 1937. *In German.*—In Drude's second method of measurement of dielectric liquids a condenser containing the liquid is used to bridge the two wires of the Lecher system. In the present paper the correction necessary when the liquid has a high conductivity is deduced mathematically. In addition, a theoretical treatment is given of the application of the reactance variation method to Lecher wires. The loss in the system is a simple function of the change of reactance which reduces in a given ratio the current flowing at resonance. W. H. W.

*See also* Abstract 4961.

## ELECTROCHEMISTRY.

**5081. Concentration Cells in Molten Media. S. A. Pletenev and V. N. Rozov.** *Acta Physicochimica,* 7. 3. *pp.* 339–356, 1937. *In English.*—It is shown that the e.m.f.s of concentration cells in molten media are linear functions of the logarithms of the mole fractions corresponding to the salts of the metals studied, and it is ascertained that the character of this linear relation is different in presence of chemical combinations between the salt of the metal studied and the salts used as a " medium."

**5082. Centres of Crystallisation Formed in Electrolysis. A. T. Wahramian and S. A. Alemian.** *Acta Physicochimica,* 7. 1. *pp.* 95–100, 1937. *In German.*—$AgNO_3$ solution is electrolysed in a cell of special design and the number of centres of crystallisation which appear on the Pt kathode is observed in a microscope. For each electrolyte concentration the numbers of centres observed in different experiments are grouped around a most probable number, which is found to be inversely proportional to the electrolyte concentration. The factor of proportionality is dependent upon the temperature, nature of electrode, applied potential, etc. L. A. W.

**5083. Transference Numbers in $D_2O$ and its Mixtures with $H_2O$. L. G. Longsworth and D. A. MacInnes.** *Am. Chem. Soc., J.* 59. *pp.* 1666–1670, *Sept.,* 1937.—Transference and conductance measurements on solutions of several electrolytes in $D_2O$ and its mixtures with water have been made. The investigation included 0·05 *N* solutions of KCl and HCl–DCl in a wide range of $H_2O$–$D_2O$ mixtures. The conductance of the chloride ion constituent from these two chlorides varies nearly linearly with the mole fraction of $D_2O$ in the mixed solvent. The H–D component, on the other hand, shows wide variations from linearity, thus indicating a complex conductance mechanism. Measurements have also been made on solutions of NaCl, KCl and HCl–DCl at several concentrations in nearly pure ($N_{D_2O} = 0{\cdot}9935$) $D_2O$. From these data limiting values of the ion conductances have been computed for $D_2O$. AUTHORS.

**5084. Mechanism of Processes at the Oxygen Electrode. W. Roiter and R. Jampolskaja.** *Acta Physicochimica,* 7. 2. *pp.* 247–260, 1937. *In German.*—The polarisation phenomena at the Pt–$O_2$ electrode have been re-investigated. For kathodic polarisation in *N*/10 $H_2SO_4$ the observations agree with the equation $e = a - b \log_e I$ ($b = 0{\cdot}11$ to $0{\cdot}12$), which is analogous to that governing $H_2$-overvoltage. The value of *b* approximates to that calculated from the theory of Erdey-Gruz and Volmer. Temperature influences the polarisation considerably, affecting the value of *a* much more than that of *b*. A similar relationship to the above holds for anodic polarisation. The primary process in the ionisation of oxygen is $O_2 + e \rightarrow O^- + O$, and that in the discharge $OH^- - e \rightarrow OH$. The possibility of the production of $H_2O_2$ is considered. A. J. M.

**5085. Platinum Electrode. B. Ershler.** *Acta Physicochimica*, 7. 3. *pp.* 327–338, 1937. *In English.*—A smooth Pt electrode was constructed which practically could be considered as perfectly polarisable. The depolarisation current for this electrode was of the order of $10^{-10}$ A/cm$^2$. Charging curves were measured for smooth Pt in various solutions. These curves are in the main similar to those obtained for the platinised electrode, and show the same dependence of $H_2$ adsorption upon the composition of the electrolyte. The charging curves are, however, less reversible than the curves obtained with the platinised electrode. Slow processes take place on the electrode during its charging at potentials within the double layer region. The possible significance of those processes is discussed. The quantity of H atoms on 1 cm$^2$. of the surface of the smooth Pt electrode at the reversible H-potential can be calculated. This quantity is nearly equal to the number of Pt atoms on the same surface. [See also Abstract 2242 (1937).] AUTHOR.

**5086. Effect of Water on Potential of Glass Electrode. H. Yoshimura.** *Chem. Soc. Japan, Bull.* 12. *pp.* 359–366, *Aug.*, 1937.—When one surface of the membrane is dried, the asymmetric potential on that side is raised, and the H-electrode function decreased. On wetting, the reverse occurs. These facts can be explained qualitatively by any of the recent theories. The generally accepted importance of keeping the glass electrode submerged after preparation, can be explained as follows: (1). The H-electrode function approaches the theoretical Nernst value, the kation effect probably decreasing. (2). The asymmetric potential decreases. (3). The equilibrium value is attained more rapidly in use. D. R. H.

**5087. Normal Volta Potentials of Two-Phase Systems. O. Klein and E. Lange.** *Zeits. f. Elektrochem.* 43. *p.* 826, *Oct.*, 1937.—Corrections to the original paper [see Abstract 4180 (1937).]

*See also* Abstracts 4780, 5075.

## ELECTRONS, POSITRONS AND PROTONS, INCLUDING APPLICATIONS.

**5088. Properties of a Monochromatic Electron Beam After Transmission Through an Absorbing Foil. J. J. Trillat and A. Hautot.** *Ann. d. Physik*, 30. 2. *pp.* 165–168, *Sept.*, 1937.—An analysis is made of the velocities of electrons transmitted by a metal foil, only those electrons which do not suffer deflection being considered. F. Kirchner and also A. Becker and E. Kipphan have shown that the emergent electrons have a range of velocities the lowest of which may be considerably below that of the incident beam, whilst the intensity maximum is shifted to a lower position. An accurate study by the method of electron diffraction is described by the authors in which they canalise an electron beam and with the aid of very small diaphragms and a constant source of potential obtain a parallel beam which is monochromatic (potential variations not more than 0·2%). Crystalline Au or Al foil or celluloid films of thickness 0·5 to 2$\mu$ are used as absorbers whilst Ni or Au foil is used as an analyser over the range 23–46 kV. In all cases the diffraction pattern after transmission is identical with that before, whilst the sharpness of the images is the same. It is thus concluded that those electrons which are transmitted without any deviation in the foil do not suffer any loss in velocity. Magnetic resolution of the transmitted beam leads to the same conclusion. H. J. H. S.

**5089. Fluctuation Phenomena in the Passage of High-Energy Electrons through Pb. W. H. Furry.** *Phys. Rev.* 52. *pp.* 569–581, *Sept.* 15, 1937.—Two fluctuation problems attending the passage of high-energy electrons through Pb are discussed mathematically, (1) the fluctuations in the size of showers produced by single electrons or photons, and (2) fluctuations in energy loss of electrons. The approximations are such that the results are applicable only to thin layers of heavy substances. The conclusion is that the distribution should be essentially of the type $P(n\,;(n)) = ((n))^{-1}\{1 - ((n))^{-1}\}^{n-1}$, where $(n)$ is the mean number; but that under ordinary experimental conditions the number of very small showers should be rather greater than that indicated by this law. The occasionally observed production of large showers (~20 or 30 particles) from small thicknesses of Pb and the appearance which many of the large showers have of originating at a single point near the bottom of the Pb are satisfactorily explained. A method is given for constructing energy loss distribution curves corresponding to any assumed form of the *Bremsstrahlung* spectrum. A solution is outlined for the problem of using accurate and detailed information on the energy losses to compute an empirical spectrum curve. F. C. C.

**5090. Theory of Townsend Method of Measuring Electron Diffusion and Mobility. W. P. Allis and Harriet W. Allen.** *Phys. Rev.* 52. *pp.* 703–707, *Oct.* 1, 1937.—The Lorentz method is applied to the combined drift and diffusion of the electron stream in the Townsend experiment. The zeroth-order approximation is found to lead to the equation found by Townsend. It is shown how the next approximation is obtained. The same method is then applied to the drift of electrons in crossed electric and magnetic fields. It is found that the magnetic field changes the energy distribution as well as the direction of drift. The latter is found in close agreement with Townsend, but not with Huxley. [See Abstract 3854 (1936), and following Abstract.] AUTHORS.

**5091. Electron Temperatures and Mobilities in the Rare Gases. Harriet W. Allen.** *Phys. Rev.* 52. *pp.* 707–710, *Oct.* 1, 1937.—The results of the theory [see preceding Abstract] are applied to the computation of electron "temperatures" and drift velocities in the rare gases: He, Ne and A. Curves are given showing the effect of the variable cross-sections on the distribution function in the three cases. A distribution function is derived to account for energy lost by inelastic impact at higher values of $E/p$. This distribution function depends on an adjustable parameter, $\epsilon_1$, which has a value between the first resonance potential and the ionisation potential, since it is assumed that the number of electrons with energies above $\epsilon_1$ is negligible. Curves are given comparing the computed values of electron "temperatures" and drift velocities with experimental values. In most cases the check is good. [See following Abstract.] AUTHOR.

**5092. Plasma Electron Drift in a Magnetic Field with a Velocity Distribution Function. L. Tonks and W. P. Allis.** *Phys. Rev.* 52. *pp.* 710–713, *Oct.* 1, 1937.—Previous calculations of the drift motion of electrons moving through a gas under the combined action of electric and magnetic fields and concentration gradient have been based upon inexact averaging methods. For electrons which, like arc plasma electrons, have a Maxwell distribution to a first approximation, the first-order correction to the distribution function which arises from drift motion is now calculated. This permits exact averaging of component velocities to be carried out.

The resulting equations are compared with Townsend's earlier results. Tonks' theorem that "the drift speed is the same as would occur if the components of concentration gradient and electric field perpendicular to it, as well as the magnetic field itself did not exist" is found to hold within 12%. [See preceding Abstract.] AUTHORS.

**5093. Emission of Secondary Electrons from Metallic Surfaces. R. Warnecke.** *Onde Élec.* 16. *pp.* 509–540, *Sept.*, 1937.—The laws of emission of secondary electrons from metallic surfaces are collected with particular reference to the emission of such electrons in triodes and similar tubes. The relation between the intensity of secondary emission and the speed of the primary electrons, and the effect of heat treatment of the electrodes on this relationship are discussed. The effect of temperature on the secondary emission is considered. The variation of the emission with different metals is discussed in connection with the atomic number of the metal. The variation with angle of incidence of the primary electrons is also considered. The angular distribution of secondary electrons, the fine structure of secondary-emission curves, and the time elapsing between primary collision and secondary emission are discussed. A. J. M.

**5094. Distribution of Secondary Electrons Liberated by Al Nets. C. Hagen and M. Sandhagen.** *Zeits. f. Physik*, 107. 1–2. *pp.* 132–137, 1937.—The number and angular distribution of secondary electrons emitted by an Al net of 1200 mesh/cm$^2$, and with a transmission factor of about 45% when it is placed between two diaphragms at various potentials is measured. The arrangement of the anode is that found in the secondary electron multiplier. The results are given in graphical form for a number of anode potentials. [See also Abstract 2245 (1937).] H. J. H. S.

**5095. Velocity Distribution of Secondary Electrons Emitted by Gases under the Action of Kathode Rays. F. Frey.** *Ann. d. Physik*, 30. 3. *pp.* 297–312, *Oct.*, 1937.—The velocity distribution of secondary electrons emitted by a gas under reduced pressure in a field-free space when bombarded by a beam of kathode rays, accelerated through potentials up to 500 V, is investigated by Lenard's opposing field method. To a first approximation the velocity distribution of the secondary electrons was independent of the velocity of the primary kathode rays up to 500 V. As is the case with metals, most of the secondary electrons have very small velocities. It is shown that scattered primary electrons reach the Faraday cylinders, but that the quantity decreases rapidly as the accelerating potential of the primary beam is increased beyond the ionisation potential. It was not found possible to effect a complete separation of the secondary and scattered primary electrons. The influence upon the results of direction-distribution of the electrons, design of apparatus and gas pressure are discussed, and the results are compared with those of other workers. A. G. Q.

**5096. Resonance and Transfer of Charge. F. Wolf.** *Ann. d. Physik*, 30. 4. *pp.* 313–332, *Oct.*, 1937.—In extension of previous work [see Abstract 2806 (1937)] an account is now given of the measurement of the transfer cross-section in six more collision processes. A summary of all the previous experiments—25 in number—is shown and the effect of a slight deviation from the strict resonance conditions is discussed. The amount of transfer which occurs is greater, the nearer the conditions are to strict resonance. The experimental curves agree roughly with the resonance curves theoretically to be expected. The deviations which occur are related to special states of excitation, and these deviations are found to occur more often at the higher velocities of the colliding particles. G. G.

**5097. Defects in Electron Images. W. Rogowski.** *Arch. f. Elektrot.* 31. *pp.* 555–593, *Sept.* 15, 1937.—The third-order defects of an electron image are deduced with the help of the Hamiltonian characteristic function. This function may be used to calculate terms up to the fourth order for a beam of electrons and the results may then be compared with those for the ideal case of a single ray, from which it follows that the defects may be determined. The subject is treated in three sections: (1) The fundamentals of electron optics are described and the properties and application to electron optics of the characteristic function of Hamilton are discussed. (2) Image defects in an axially-symmetric electric field are worked out, *viz.*, spherical aberration, coma, astigmatism, curvature of field and distortion. (3) The defects of an electric and magnetic field are calculated; in addition to the former aberrations, magnetic rotation, magnetic "twisting" and magnetic "wringing" (magnetic coma) are also considered. H. J. H. S.

**5098. Spherical Aberration of Weak Electron Lenses. R. Rebsch and W. Schneider.** *Zeits. f. Physik,* 107. 1–2. *pp.* 138–143, 1937. —For a weak "einzellinse," the shape of the electrodes for a minimum spherical aberration is extremely complicated and an attempt is made to determine an electrode form which is easier to produce and which will give approximately the same spherical aberration. A factor is defined by means of which the various arrangements may be compared. A ring surrounded by a diaphragm which almost touches it gives a spherical aberration of 25% more than the "einzellinse" whilst a system of two similar rings in close proximity and oppositely charged gives a value of only 10% greater. Calculations are also carried out on weak magnetic lenses and it is proved that, in a combined system of lenses, it is impossible to obtain a lens which has a better spherical correction than that of the better of the components. [See also Abstracts 3864 and 4366 (1936)]. H. J. H. S.

*See also* Abstracts 4770, 4771, 4776, 4805, 4806, 4916, 5064, 5067, 5099, 5114, 5129.

## ELECTROSTATICS.

**5099. Two Applications of the Sommerfeld Method of Split Potentials. L. Waldmann.** *Phys. Zeits.* 38. *pp.* 654–663, *Sept.* 1, 1937.—The method of split potentials described by Sommerfeld is applied to a discussion of the potential variations along the axis of a circular plate condenser and of an electron optical "immersion" lens consisting of a plane kathode, a kathode ring and an anode ring. In the latter case, the effect of varying the dimensions of the system is studied. H. J. H. S.

**5100. Removal of Static Charges from Glassware. F. W. van Straten and W. F. Ehret.** *Indust. and Engin. Chem.* (*Analytical Edition*), 9. *pp.* 443–445, *Sept.* 15, 1937.—A generally applicable method is proposed for removing, by means of a h.f. discharge, electrostatic charges from glassware prior to weighing. By modifying the size and shape of the electrodes a zone of discharge may be obtained that will accommodate and, in less than a minute, completely discharge ordinary glass vessels such as those used in macro- and microanalysis AUTHORS.

*See also* Abstracts 4839, 5009.

## GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS.

**5101. Influence of Magnetic Field and Temperature on Resistance of Gallium Single Crystals. W. J. de Haas and J. W. Blom.** *K. Onnes Lab., Leiden, Comm. No. 249c. Physica, 4. pp. 767–777, Oct.,* 1937. *In English.*—Ga single crystals have a different increase of the resistance in a magnetic field perpendicular to the wire according as the length is parallel to the one or the other of the shorter axes of the crystal lattice (rhombic). This method of distinguishing these axes is better than those involving the outward shape, the reflection of X rays, or the electrical resistance, for example. A tendency to interchange the rôles of the shorter axes with lowering of the temperature is found. [See also Abstract 2253 (1937).]
AUTHORS.

**5102. Change of Resistance of Single Crystals of Gallium in a Magnetic Field. Part IV. W. J. de Haas and J. W. Blom.** *K. Onnes Lab., Leiden, Comm. No. 249d. Physica, 4. pp. 778–790, Oct.,* 1937. *In English.*—At liquid hydrogen temperatures the increase of the resistance of a Ga single crystal in a magnetic field varies in a complicated manner with the orientation of the lines of force with respect to the current. $\Delta R_{\parallel}$, the increase when the field lines are parallel to the current, shows a saturation tendency at high field-strengths. The temperature dependence of $\Delta R_{\parallel}$ is also in contrast with the normal one, as $\Delta R_{\parallel}/R_{0^\circ C}$ decreases with decreasing temperature. [For Part III see Abstract 5223 (1935).]
AUTHORS.

**5103. Crystal Structure and Electrical Properties. Part VII. Conductivity Anisotropy of Bi Crystals. O. Stierstadt.** *Zeits. f. Physik,* 107. 1–2. *pp.* 51–63, 1937.—It is shown that the electrical conductivity anisotropy of a crystal lattice in a magnetic field cannot be unequivocally defined as, in general, each plane or straight line in the crystal structural network is characterised by its own "eigen" anisotropy. The case of a Bi crystal in a transverse or longitudinal magnetic field is discussed in considerable detail. [For Part VI see Abstract 3652 (1935)].
J. S. G. T.

*See also* Abstracts 5072, 5073.

## MAGNETISM AND ELECTROMAGNETISM.

**5104. Ferromagnetism. O. v. Auwers.** *Ergeb. d. exakt. Naturwiss.* 16. *pp.* 133–182, 1937.—Four types of magnetism are differentiated—diamagnetism, Langevin paramagnetism (varies with temperature), metal-paramagnetism (independent of temperature) and ferromagnetism. The exchange effect is postulated as the fundamental basis of ferro and anti-ferromagnetism and support is given to this view by a consideration of experimental results on binary alloys which consist of dilute solutions of any metal in a ferromagnetic lattice, and the relation of these results to the periodic classification is discussed. A number of possible arrangements of parallel and antiparallel spin couplings of neighbouring atoms in relation to the number of outer electrons is suggested. The peculiar problems which arise in the case when a ferromagnetic metal is dissolved, in a high degree of concentration, in another ferromagnetic are described and discussed, particular mention being made of the problems relating to the Curie temperatures. A summary is given of the results so far obtained on anisotropy of the 1st and 2nd orders, as well as the properties and behaviour (especially with respect to lattice changes) of permanent magnet materials. An up-to-date Bibliography is appended. [See following Abstract]. H. J. H. S.

**5105. Laws of Magnetic Binding. O. v. Auwers.** *Wiss. Veröff. a d. Siemens-Werken*, 16. 2. *pp.* 92–116, 1937.—Values of magnetic moments are examined to investigate regularities in the appearance of parallel and non-parallel spin couplings both in the periodic system and in binary metal alloys. Of the four types of magnetism, diamagnetism, Langevin- and metal-paramagnetism and ferromagnetism, it is shown that in the first two no exchange effect occurs but that it does in the last two. This exchange effect can be brought about by the two possible arrangements of the spin of an anti-parallel system of spin moments of neighbouring elements (metal-paramagnetism independent of temperature, " antiferromagnetism ") or by a parallel arrangement (ferromagnetism). The laws which determine which of these two groups shall appear show a marked relation to the number of the spin moment of the incomplete shells of the cooperating partner. An extension of the Hund law for the atom is thus suggested. [See preceding Abstract]. H. J. H. S.

**5106. Directional Ferromagnetic Properties of Metals. R. M. Bozorth.** *J. of Applied Physics*, 8. *pp.* 575–588, *Sept.*, 1937.—The crystal structures of Fe and Ni and their magnetisation curves in principal crystallographic directions are described, followed by a description of the work of Beck on the anisotropy of single crystals of Fe-Si. The theory of anisotropy in high fields is then developed and experimental results are given in illustration. Anistropy in low fields is next considered and the method of determining anisotropy constants by torque measurements on a disc or oblate spheroid is described. The effect of composition on the anisotropy of Fe is described and the results of McKeehan and others relating to this are discussed. Alloys having weak anisotropy are of interest and these are considered, special reference being made to the permalloys and of the effect of strain upon them. The influence of temperature on the anisotropy of Fe, Co and Ni is described. An account is given of some new results on the magnetisation of single crystals of pure Fe. H. J. H. S.

**5107. Magnetic Properties of Iron-Iridium Alloys. M. Fallot.** *Comptes Rendus*, 205. *pp.* 517–518, *Sept.* 20, 1937.—The variations with content of Ir (up to 15% Ir) of the Curie point, $\alpha \rightarrow \gamma$ and $\gamma \rightarrow \alpha$ transformations and magnetic moment of these alloys are shown by curves. These closely resemble those for alloys of Fe with Ru and Os. [See Abstract **4704 (1937)**. C. A. S.

**5108. Magnetic Properties of Single Crystals of Silicon Iron. H. J. Williams.** *Phys. Rev.* 52. *pp.* 747–751, *Oct.* 1, 1937.—The magnetisation curves for the [100], [110] and [111] directions of single crystals of Fe containing 3·85% Si were obtained from single crystal specimens cut in the form of hollow parallelograms so that the sides of each specimen were parallel to the tetragonal, digonal or trigonal axes, respectively. This method avoids the errors due to demagnetising fields, inherent in previous measurements on single crystals. In addition to the well-known anisotropy at magnetisations above half of saturation, the data show for the first time considerable anisotropy at low magnetisations. A maximum permeability of 1,380,000, by far the highest ever reported for Si-Fe, was observed in the [100] specimen after careful annealing. The magnetic anisotropy constants $K_1$ and $K_2$ were obtained from the magnetisation curves and from torque measurements on a disc cut parallel to a [110) plane. AUTHOR.

**5109. Iron Ammonium Alum in Alternating Fields at Very Low Temperatures. A. H. Cooke and R. A. Hull.** *Roy. Soc., Proc.* 162*A. pp.* 404–413, *Oct.* 1, 1937.—The irreversible heating of iron ammonium alum by an alternating magnetic field has been measured between 0·035° and 0·11° K. The heating is found to vary as the square of the field amplitude, and as the square of the frequency. It increases rapidly as the temperature is lowered. If these results are interpreted by a relaxation time, corresponding to a lag between the applied magnetic field and the induced magnetisation, it varies from $9 \times 10^{-8}$ sec. at 0·035° K. to $10^{-8}$ sec. at 0·11° K. It is shown that this time refers to that necessary for the magnetic ions, the spins, to take up their stable orientations in the field, rather than that necessary for the communication of the energy of magnetisation from the spin system to the lattice system. A discussion is given of the conditions under which this irreversible heating may be minimised in calorimetric experiments with a.c. methods of temperature measurement. AUTHORS.

**5110. Temperature Dependence of Diamagnetism in $\gamma$-Brasses. C. T. Lane.** *J. of Applied Physics,* 8. *pp.* 693–697, *Oct.*, 1937.—A series of measurements on the temperature dependence (20°–700° C.) of the diamagnetic susceptibility of several $\gamma$-phase brasses are reported. At room-temperature the susceptibility is a linear function of composition, in agreement with previously reported work. At higher temperatures, however, this linearity no longer holds, the departure being greater at the higher temperatures. At the Cu-rich end of the phase the susceptibility increases with temperature, while at the Zn-rich end the reverse is true, and the susceptibility is sensibly constant near the theoretical composition $Cu_5Zn_8$. The bearing of these results on the Bloch theory of metals is discussed. AUTHOR.

***5111. New Method for Determining Magnetic Properties of Iron. L. Triau.** *R.G.E.* 42. *pp.* 264–268, *Aug.* 28, 1937.—A portable instrument termed a " ferrometer " is described. It embodies a new type of mechanical rectifier which completely cuts off reverse current, has an effective resistance of about 1 ohm, but is limited to frequencies of about 1000 ∼. It is reliable for frequencies from 25 to 150 ∼, which are those normally used, and it may be employed with advantage for testing sheet iron at 50 ∼. The specimen under test is preferably a ring wound with a primary and a secondary coil. The construction of the ferrometer is described in detail and formulæ are given whereby the maximum induction, the power consumed per kg. and the effective permeability of the material may be calculated from the ferrometer readings. The instrument may be coupled to a recording mechanism consisting of two mirrors at right angles in order to record hysteresis curves. H. J. H. S.

***5112. Vibration Magnetometer. J. Groszkowski.** *Journ. Sci. Instruments,* 14. *pp.* 335–339, *Oct.*, 1937.—A vibration magnetometer for the measurements of magnetic fields of 1–30,000 gauss is described. The action of the magnetometer depends on the measurement of the e.m.f. induced in a small search coil which vibrates with known amplitude and frequency in the magnetic field to be measured. The e.m.f.—after magnification by means of a valve amplifier—is read on a rectifier type voltmeter, calibrated directly in gauss. The instrument is operated from 50-cycle supply mains. AUTHOR.

*See also* Abstracts 4852, 5055.

## MEDICAL RADIOLOGY AND ELECTROLOGY.

**5113. Absolute Cardiogram. F. Schellong ; H. E. Hollmann and W. Hollmann.** *Zeits. f. Instrumentenk.* 57. *pp.* 380–383, *Sept.*, 1937.—A criticism by Schellong of a paper by H. E. and W. Hollmann [see Abstract 4211 (1937)], including a reply by the authors. G. E. B.

**5114. Examination and Recording of Human Electrocardiogram by the Kathode-Ray Oscillograph. D. Robertson.** *I.E.E., J.* 81. *pp.* 497–509 ; *Disc.*, 509–514, *Oct.*, 1937.—The kathode-ray oscillograph, having no inherent inertia and yet being comparatively indestructible, is an instrument peculiarly suitable for everyday electrocardiography. A fluorescent screen of very long afterglow enables the electro-cardiogram to be examined directly at the patient's bedside, which is a new facility. The design of the amplifier has to be adapted to the peculiarities of the heart-action voltages and electrical constants of the patient ; these are considered in some detail, and practical methods for the examination of the adequacy of the amplifier are discussed. The provision of a h.v. supply suitable for any eventuality is considered, together with methods of obviating interference, especially from a.c. mains. AUTHOR.

***5115. Physiological Lecture Demonstration Apparatus. G. H. Bell, J. R. Bell, J. A. C. Knox and A. R. Smellie.** *Journ. Sci. Instruments*, 14. *pp.* 330–335, *Oct.*, 1937.—Apparatus suitable for demonstration of physiological experiments to large audiences is described. A photoelectric method capable of very general application is used for the projection on the lantern screen of movements of organs, pulse waves, etc. ; a photoelectric manometer enables blood pressure tracing to be projected. A microphone, relatively free from feed-back effects, is described for picking up heart and arterial sounds. AUTHORS.

***5116. Biological Use of Ultra-Short Waves. H. E. Hollmann.** *Hochfrequenztechn. u. Elektroakustik*, 49. *pp.* 81–91, *Sept.*, 1937.—The author considers the effect of ultra-short-wave radiation of biological objects, more from the non-thermal action of h.f. waves on cells than the purely thermal effects which are utilised in electrotherapy. Apparatus for the concentration of the rays by reflection is described, together with a development of the theory of internal reflections and penetrations. Under certain circumstances resonance within layers of fat is observed and accounted for. L. E. C. H.

**5117. Power Measurement in Short-Wave Therapy. E. Mittelmann.** *E.u.M.* 55. *pp.* 461–465, *Sept.* 19, 1937.—The difficulties of power measurement at the high frequencies used in short-wave therapy are discussed, with particular reference to the power absorbed by the patient. A method is described whereby the equivalent resistance of the patient is measured by a resonance method and the power then calculated from current or voltage measurements. E. O. T.

**5118. Radiating Surfaces. J. van Roojen.** *Brit. J. of Radiology*, 10. *pp.* 650–676, *Sept.*, 1937.—Treatment of malignant tumours by $\gamma$-rays requires geometrical homogeneity over the whole extent of the invaded tissues. This is not normally attained, and the author investigates the case mathematically and gives curves showing successive positions of the point of radiation for various distances. E. H. W. B.

*See also* Abstracts 4917, 4920, 5009.

## OSCILLATIONS AND WAVES.

***5119. Calibration of Audio-Frequency Oscillators. N. F. Astbury.** *Journ. Sci. Instruments,* 14. *pp.* 339–341, *Oct.,* 1937.—The note describes a simple method of comparing an unknown frequency with a harmonic of a standard frequency, a copper-oxide rectifier being used to rectify the resulting beats. In particular, the use of the 50-cycle public supply as a frequency standard is described, the harmonic content of the mains being increased by distorting the supply with a rectifier. With this arrangement frequencies up to 2500~ can easily be checked against the mains, higher frequencies being obtainable under favourable conditions. There are no inductive coils or tuned circuits in the arrangement, and the power consumption is very small. AUTHOR.

**5120. Electromagnetic Waves in Plane Non-Homogeneous Fields. V. Kupradze.** *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 16. 3. *pp.* 165–168, 1937. *In German.*—Discusses the solution of a " weighted " integral equation which occurs in diffraction theory and other problems. W. S. S.

**5121. Characteristics of the Ionosphere at Washington, D.C., January-July, 1937. T. R. Gilliland, S. S. Kirby, N. Smith, and S. E. Reymer.** *I.R.E., Proc.* 25. *pp.* 1174–1191, *Sept.,* 1937.

**5122. Regularities and Irregularities in the Ionosphere. Part I. E. V. Appleton.** *Roy. Soc., Proc.,* 162*A. pp.* 451–479, *Oct.* 15, 1937.—Selected topics from the information derived from radio sounding of the ionosphere are discussed and considered in connection with results derived from a theory of simple layer formation by solar ionising radiation, travelling rectilinearly and attenuated according to a mass-absorption law. The comparisons are concerned chiefly with the maximum electron content $N_m$ with solar radiation angle of incidence $\chi$, with the total electric conductivity for direct currents such as determines the quiet day magnetic variations and with the h.f. absorption of radio waves traversing such a simple layer, the last two quantities being, to some extent, related. Other matters discussed are (*a*) ionisation decay processes in the ionosphere, (*b*) the actual height at which radio waves are reflected and (*c*) ionospheric disturbances. A. W.

**5123. Unusual Conditions of Ionosphere and Relation to Northern Lights and Terrestrial Magnetism. G. Leithäuser and B. Beckmann.** *Zeits. f. techn. Physik,* 18. 10. *pp.* 290–299, 1937.—In the F-region of the ionosphere disturbances are frequently observed, particularly in the evening and at night, which behave as if charges are formed which differ from the normal F-regional ionisation in their non-homogeneous cloudlike character. They result in a raising of the F-layer and frequently cause a complete failure of F-layer reflection, in which case a diffuse reflecting layer is generally found at a great height. Such disturbances always appear to be accompanied by terrestrial magnetic disturbances. The connection between these two effects is discussed and also the connection between solar activity, the northern lights and similar ionospheric disturbances. A. W.

**5124. Ionospheric Disturbances, Fade-Outs and Bright Hydrogen Solar Eruptions. D. F. Martyn, G. H. Munro, A. J. Higgs and S. E. Williams.** *Nature,* 140. *pp.* 603–605, *Oct.* 9, 1937.—For some months daily records have been taken in Australia of the equivalent heights and reflection coefficients of the $F_2$-region of the ionosphere, for radio frequencies near to the critical penetration frequency of the region. Under these conditions the recorded quantities are exceptionally sensitive to small changes in the electron density of the $F_2$-region. The results obtained show the frequent occurrence of a type of disturbance which has the following features: (*a*) The equivalent height rises sharply in a period of a few minutes. (*b*) The intensities of the reflected echoes increase at the same time as (*a*). (*c*) After some minutes the heights decrease and the intensities return to normal. (*d*) The $F_2$-region is left higher than before although the $F_2$ electron density has returned to its original value. A portion of a record of such a disturbance is given. Such disturbances were found on several occasions to coincide with a fade-out of all signals from short-wave transmitting stations throughout Australia, while only a few overseas transmitters were heard, with greatly reduced intensity. There is strong evidence that every solar eruption observed at the Commonwealth Solar Observatory occurs almost simultaneously with an ionospheric disturbance of the above type and that the major effects produced in the ionosphere during an eruption are due to solar emission of the Lyman resonance line $L_\alpha$ (1215·6 Å) of H, which must be emitted in great intensity from the eruptive area. A. W.

**5125. Ionosphere Observations During the Total Eclipse of the Sun of June 19th, 1936. V. Kessenikh, H. Baerwald, N. Bulatov, V. Denisov.** *Techn. Phys., U.S.S.R.* 4. 6. *pp.* 466–484, 1937. *In English.*—These observations were carried out by the Siberian Physico-Technical Institute, Tomsk ($\phi = 56° 28'{\cdot}1$ (N); $\lambda = 84° 56'{\cdot}2$ (E) between June 15th and June 24th, 1936. Particular attention was given to the examination of the $F_2$- and D-regions. The measurements of critical frequency and absorption showed a reduction of $F_2$-ionisation at the time of the supposed corpuscular eclipse of particles with velocities of 1600–2000 km./sec.; decrease of ionisation of the $F_2$- and D-layers also took place during the period of the optical eclipse. The eclipse of June 19th, 1936, took place at a period of intensive magnetic storms caused by an increase in solar activity. Rapid fluctuations of solar radiation were superimposed upon the effect of the eclipse thus apparently intensifying the effects of the corpuscular eclipse. The main conclusions from the observations may be summarised as follows: it is once more confirmed that u.v. solar radiation plays an important part in the ionisation of the $F_2$-region; it is established that u.v. radiation is largely responsible for the ionisation of the absorbing D-region; the existence of a pronounced effect of solar corpuscles on the ionisation of the $F_2$-region is made highly probable. AUTHORS.

**5126. Photoelectric Method for Tracing Current Wave-Forms. W. S. Huxford and R. W. Engstrom.** *Rev. Sci. Instruments,* 8. *pp.* 385–390, *Oct.,* 1937.—A photoelectric timing-circuit arrangement has been designed to obtain point by point plots of periodically varying currents. The circuit employs a 3-electrode vacuum photo-tube in which electron emission occurs only when a sudden light flash enters the cells through a narrow slit in a disc driven by a synchronous motor. A non-inductive resistance carrying the current to be measured is inserted in the grid circuit of the photo-triode. The electron emission registered by a galvanometer in the collector circuit is completely controlled by the momentary value of the potential set up in this resistance by the current at the instant of the light flash. In this manner, by changing the time at which the light flash occurs in the current cycle, a complete delineation of the current wave form is secured. The method eliminates distortion in wave-form introduced by mechanical oscillographs and by amplifiers used with kathode-ray oscillographs when small currents or potentials are to be measured. AUTHORS.

*See also* Abstracts 4896, 4906, 5068, 5114.

## PHOTOELECTRICITY.

**5127. Inner Photoelectric Effect in Crystalline Cuprous Oxide. G. Faltz.** *Ann. d. Physik*, 30. 2. *pp.* 193–208, *Sept.*, 1937.—Measurements similar to those of Volmer and Moll on Se [see Abstract 802 (1933)] are carried out for crystalline $Cu_2O$ on Cu. The $Cu_2O$ electrode is opposed to a calomel electrode and KCl, NaCl, $NH_4Cl$, $CuSO_4$ and $CuCl_2$ are used as electrolytes. For the incident wave-lengths 365, 405 and 436 $m\mu$ it is found that the magnitude of the light effect, as measured by the current required to maintain the dark potential during illumination indicates the liberation of one electron per absorbed quantum. Measurements are also made upon the short-circuit current without external e.m.f., using illumination with frequencies from 50 to 1000∼. The short-circuit current is found to be proportional to the incident intensity up to $40\mu W$ per $cm^2$. and practically independent of the nature, concentration and temperature of the electrolyte. The spectral distribution again indicates the validity of the quantum equivalent. From these results it is concluded that the non-existence of photo-conductivity in the region of strong absorption is not (as has been suggested) due to the photoelectric effect being confined to imperfections in the crystal lattice. Finally, an account is given of a method whereby " images " may be produced on the electrode surface by illumination. L. A. W.

*See also* Abstracts 4781, 4947, 4959, 5115, 5126.

## PIEZOELECTRICITY.

**5128. Influence of Temperature on the Dynamic Piezo-Modulus of Rochelle Salt. G. Mikhailov.** *Techn. Phys., U.S.S.R.* 4. 6. *pp.* 461–465, 1937. *In English.*—The value of the peizo-modulus $d_{14}$ was determined during vibration of a specimen of Rochelle salt along its length, orientated at an angle of 45° to the *hc* axes in fields of between 1 and 2 V/cm. at a frequency of $10^5$ ∼. The character of the resulting relationship is analogous with the change in the dielectric constant of Rochelle salt in dependence on the temperature. The dynamic values of $\epsilon$ and $d_{14}$ at $t = 0°$ C. are about 60 times less than the static values. The work was carried out between temperatures of 0° C. and 40° C. and maximum value of $d_{14}$ was found for the upper Curie point at about $t = 24{\cdot}5°$ C. AUTHOR.

## THERMIONICS.

**5129. Electron Microscope Observation of Field Kathodes. E. W. Müller.** *Zeits. f. Physik*, 106. 9–10. *pp.* 541–550, 1937.—An etching method is described for obtaining an extremely fine metallic point which is suitable for studying field emission. By using the point as a kathode in an electron microscope, a lateral magnification of $2 \times 10^5$ may be obtained. The point consists of a single crystal and the electron microscope images give important information on the dependence of the field emission on the crystal structure. The electron emission of a number of crystallographic planes is investigated and photographs are given to illustrate the results. The work functions of the different crystallographic planes is deduced from the electron emission from the planes. The adsorption of Th or $O_2$ layers on different planes is directly observed. Measurements of the current density flowing to the point give values of up to $10^8$ A./cm$^2$. [See also Abstract 3790 (1937)]. H. J. H. S.

***5130. L.V. Positive Ion Source. W. H. Zinn.** *Phys. Rev.* 52. *pp.* 655–657, *Sept.* 15, 1937.—A positive ion source of the l.v. constricted arc type, which yields intense positive ion beams with small gas pumping, is described. Ion currents up to 4·3 mA, have been obtained using a probe canal 6 mm. long and 1 mm. in dia. Magnetic analysis, when the arc was operated in $H_2$, showed a maximum of 15 to 20% protons.

AUTHOR.

*See also* Abstracts 4956, 5093.

## THERMOELECTRICITY.

**5131. Calculation of Peltier Heat. G. P. Dube.** *Phil. Mag.* 24. *pp.* 598–599, *Oct.*, 1937.—Derives the expression for the Peltier heat directly from its definition.

**5132. Discontinuity in Thermoelectric Power of Rhodium. E. T. Booth and E. H. Dixon.** *Rev. Sci. Instruments,* 8. *pp.* 381–382, *Oct.*, 1937.—With an optical pyrometer and potentiometer the temperature e.m.f. relations of a Pt-Rh thermocouple were found between the temperatures of 850° C. and 1350° C. The experimental points lie on two parabolæ which cross each other at 1091° C. The results support the view that Rh undergoes a change of structure at 1091° C. AUTHORS.